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9.7.2058







T R A V E L S

THROUGH THE

B A N N A T

O F

T E M E S W A R,

T R A N S Y L V A N I A,

A N D

H U N G A R Y,

In the Year 1770,

DESCRIBED IN

A SERIES of LETTERS to PROF. FERBER,

O N T H E

M I N E S and M O U N T A I N S

Of these different Countries,

By B A R O N I N I G O B O R N,

Counsellor of the ROYAL MINES, in Bohemia.

To which is added,

J O H N J A M E S F E R B E R ' s

M I N E R A L O G I C A L H I S T O R Y of B O H E M I A.

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T R A N S L A T E D from the G E R M A N,

With some explanatory Notes, and a Preface on the Mechanical Arts, the  
Art of Mining, and its present State and future Improvement,

By R. E. R A S P E.

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*In nova fert animus mutatas dicere formas.*

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L O N D O N:

PRINTED BY J. MILLER, No. 6, OLD BAILEY;  
FOR G. KEARSLEY, No. 46, FLEET-STREET.

MDCCLXXVII.



2058



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## P R E F A C E.

*HAVING introduced Mr. Ferber's accounts of Italy, with some general views of those parts of Mineralogy, which have of late been improved, and may be further by a nearer examination of the Volcanoes and their various productions; it is but just that these accounts of the Hungarian and Bohemian mines should be accompanied with similar views on the art of mining; the nature of the different metallic mountains and of their various veins and productions.*

*This science has been the science of riches ever since the use of metals and of other fossils have been discovered, and turned to account by mankind. Though that discovery be a very old one, and the art of mining and of smelting be handed down to us by a long series of ages, and by different nations, some*



*of its scientific parts are, however, brought to a less certainty than we might have expected.*

*Was it, that*

Mammon, the least erected spirit, that fell  
From Heaven,

*was less adored, and his worship less followed than that of the fairer Muses? Was it*

That riches grow in Hell, that foil which best  
Deserves the precious bane?

*Indeed it was not; for gold and silver, and riches have been in every age, in every clime, adored and pursued by all the nations, which had any claim to ingenuity, with such a zealous eagerness as would have done credit to any divinity. It is the common fate of the most useful and practical arts, to have been, in every age and in every nation, left in a state of infancy, and in the hands of working people, or of imposing quacks. Sovereigns have encouraged, and the wise and learned, with presumptuous attempts, pursued hazardous flights into the lofty regions of scholastic divinity and metaphysics, beyond the reach of human abilities, and aimed at such objects, which in this world do not make us either wiser or happier, or richer or better. It is a very singular phenomenon in the history of mankind, that the arts of fortune-telling, of rhiming, of singing, fiddling, reasoning, and speaking, should have been reduced*  
into

*Scientifical forms ; nay, that they should have been so highly improved, before any friend of men and good-sense thought of reducing the better arts of husbandry, of physick, of navigation, and of mining into the forms of sciences ; of fixing them for ever, and of establishing them upon the evident and constant principles of nature. But such is the perverseness of human nature ! Wants and accidents have co-operated to invent and to introduce the useful arts by the skill and ingenuity of some men, whom the Savages in the infant state of society have justly revered as their greatest benefactors, and as such have ranked and forgot them in the croud of their heroes and divinities. Ceres and Triptolemus, Pomona, Minerva and Esculapius, for being the inventors, improvers, or introducers of husbandry, gardening, weaving, and physick, have been by the savage Greeks, Tuscans, or Latins, consecrated to posterity by the same spirit of gratitude and veneration, which has sanctified the Evangelists, the Apostles, and the Saints amongst the Christians : but Poets, time, and human incongruity, what have they made in after-times of their glory, and of the arts and sciences which they taught ? Let any one judge, who knows something of the history of mankind, whether the well-deserved reputation of their names has ever shone in its purest lustre, and whether their popular and salutary arts and sciences have ever been practised in that public-*



*spirited benevolent manner, in which they had left or delivered them to mankind. Their names and their history have been involved in clouds of darkness and legends, and their arts and sciences by their will, the inheritance of all, have been engrossed by the selfish few. This happened in a very natural manner. Whether it happened necessarily, I will not determine; observing only, that making an exclusive trade of sciences and of arts, has never answered, and never will answer, the great and universal interest of mankind.*

*The most useful arts are precisely those which stand in an immediate connexion with the most general, most natural, and most indispensable wants of mankind. Their object is food, dress, and self-preservation. They must of course have been invented or practised by every family or society of men; and being on this account coeval with the first origin of mankind, their invention falls into the remotest antiquity of the primitive world, when a few natural wants of a few individuals, or of a few scattered families, could be satisfied by common ingenuity, in making use of the most obvious gifts and effects of nature, such as every climate afforded. In that primitive state, we see the arts of the Peckerais in Terra del Fuego, and of many little wandering tribes of men in almost every part of the world; and even the arts of civilized nations would be lowered again,*  
*and*

*and turned down nearly to the same state, if by some sudden revolution they should happen to be at once deprived of the advantages of their climates, and exposed to the hardships and wants of other climates. Commodore Byron left and preserved on the coast of Chili, and the Russian sailors for many years left, and by their ingenuity and perseverance preserved, on the coast of Spitzbergen, will make good the assertion; and prove moreover, that wants and climate, going hand in hand, are the natural and first teachers of men, who for their vigour, ingenuity, and perfectibility, must be allowed to be lords of the world.*

*The self-invented arts of different nations, (and why should not a similarity of wants or causes have produced a similarity of arts and remedies?) must for these reasons have been very simple, rude, and local in the beginning; that is, they must, under different climates, have appeared under different modifications. The canoes of some Indians, made of hollowed trees, speak a climate which produces plenty of timber; the canoes of the Greenlanders, made of seal-skins, and those of the Easter-Islanders in the South-Sea, being poorly made up, and sown together, of little bits of wood, speak a dismal want of wood. The form of the Chinese buildings and columns, is plainly that of the original tent of savages, wandering in warm climates, which produced light and*



*slender bamboo-trees. The form of the Egyptian wonders of architecture seem plainly to tell, that the first inhabitants of that scorched climate, had cool rock-caverns to resort to for shelter; and that, when their increasing numbers attempted to imitate nature by art, they had little or no wood, but plenty of large rock masses. The old Indoos, being nearly under the same climate, seem to have built their most ancient Pagodas upon the same principles. The Greeks and Romans allow, that the Prototype of their most magnificent marble palaces was the original hut, made of timber, and even yet used in the milder climates of Asia. The dress of the Turks, Persians, Poles, and Hungarians, is of a different cut, but trimmed with fur, because they are offsprings of different nations in the northern parts of Asia, where dressing in fur is the advice and claim of the climate. The same original locality or nationality may be traced in the manipulations and technical words of the various arts of husbandry, hunting, fishing, fighting, and curing diseases; and as by so doing the origin of nations may be still more ascertained, and the invention of some arts pursued to their first beginning, it will likewise help us to feel, that many foreign arts have been to our cost introduced amongst us, in spite of the climate; and what here I am chiefly to insist upon, that the arts in the beginning must have been very simple and very rude.*

*Wants*

*Wants in that infant state of society of hunters and fishermen, were presently and best removed by the simplest application of those natural effects or productions, which men experienced and saw before them. The causes of things, their investigation, methodising their accidental inventions, and fixing them for aftertimes, were then absolutely out of the question; and so they were even when the encreasing numbers and wants of these unsettled wanderers made the improvement of their original arts, or the introduction of new ones from abroad, the most acceptable gifts, which friends of mankind could bestow upon them. The Greeks were indeed but a very raw and ignorant people, when their gods and heroes may be supposed to have instructed them. So were the Britons and Germans, when their conquerors, the Romans, and the first Christian missionaries or apostles, acquainted them with the arts of making their life more comfortable. Each family held them as a treasure, and handed them to their descendants in a mere traditional manner. It is no wonder, therefore, that old tradition and history speak of Princesses skilful in the arts of the loom, of Sovereigns dressing their dinners, guiding the plow, and tending their herds. Her Highness Princess Nau-sicaa went to the river washing and scowering her linen; nay, even Reverend Abbots and Holy Priests are celebrated in the first ages of Christianity amongst*



*the Northern European nations, for having been skilful and laborious plowmen, gardeners, vintners, husbandmen, carpenters, joiners, painters, and physicians.*

*This traditional science of the arts was a natural consequence of the scattered, pastoral, and rural life, and it was attended with circumstances which proved no advantage to them. Being confined to single families, and their wants alone, their practice would but accidentally improve them, and these improvements were liable to be forgotten. Moreover, their drudgery must of course be left to the slaves, who for many ages, even in the politer nations, were employed to carry on the manual arts. Deprived of liberty and property, they were the more inclined to drudge on in a dull, stubborn, habitual manner, without any mind for improvement.*

*That nevertheless, the manual and mechanical arts amongst the Phenicians, Egyptians, Greeks, Carthaginians, and Romans, have been brought to a remarkable degree of perfection, was owing, not indeed to their slaves, but to the superior good sense and activity of their masters; to circumstances which produced a nearer connection of mankind in general; to wide extended navigation, commerce, and conquests; and finally, to a mercantile spirit and a culture of science, which have ever been the results and distinguishing blessings of human society, or*  
govern-

government brought to the highest degree of perfection.

Some of these reasons have at last rescued the manual and mechanical arts in Europe from the hands of bungling slaves, and brought them into the hands of free people; but that happy revolution has in most parts of Europe served the arts only by halves. It has been a great advantage to them; but having made more or less exclusive trades of them, they have been, and some of them are still kept as jobs and secrets, by short-sighted and narrow-minded mercantile selfishness.

This plainly appears by the ill-digested statutes and customs of many professions and trades, which, if possible, would be independent patent companies, at the expence of the whole; the very names of the art and mystery of apothecaries, of clothworkers, of barbers, of cordwainers, and other trades, as expressed in the charters of their corporations at London, are striking instances to what lengths that unpatriotick selfishness has been carried in former times; and even, if the word mystery in these charters should be considered only as an equivocal, orthographical blunder, instead of mestier, or métier, there are thousands of proofs that this old spirit of selfishness is yet alive, ever willing to take advantage of the knowledge of others, and never willing to promote it. Let us add the absurd contempt in which the  
proud



*proud Barons and the self-conceited scholars have held formerly, and even yet hold, the greater part of the pretended servile and low mechanical arts, and we cannot wonder, that the progress and improvement has been so slow, and that many of them are still in a state of infancy.*

*It is only in the wisest and most enlightened ages, that we find some philosophers and wise men, stepping down from the giddy heights of their exalted station of learning, into which the barbarous ignorance of the vulgar and their own conceit had placed them, in order to fix, to rectify, and to improve the arts. Such ages produced amongst the Greeks and Romans, what Euclides, Hippocrates, Galen, Vitruvius, Columella, Cato, Pliny, Theophrastus, and some others, have left us on the arts; and it is in the true spirit of those glorious times, that after so many lost ages of scholastical dullness and mercantile selfishness, the Royal Academy at Paris, Mr. Chambers, Dr. Lewis, the Authors of the French Encyclopedia, and many friends of mankind in several parts of Europe, have undertaken of late to fix the various arts of mankind for after-times, and to establish them upon the principles of nature and mathematicks, better known at present than they ever were before. But various is their present state in different parts of Europe.*

*The Art of War is in these last two hundred years reduced in France, and especially in Germany,*  
upon

*upon so evident and scientific theories, ascertained by practice, that these powerful empires must be the most happy of all, if tremendous armies, now and then methodically butchered, and the ambition of Sovereigns, flattered by conquest, did ensure them the blessings of peace, or any other blessing at all. There has been in those countries too much occasion for the improvement of this necessary and terrible art.*

*The Nautical Art in all its branches, on the contrary, is brought in England to the highest degree of perfection, because it is the kingdom of the seas; so are husbandry and numbers of mechanical arts and manufactories, because it enjoys the advantages of a plentiful soil, and of freedom in a higher degree than any other. Sed*

*Tu regere Imperio populos Britanne memento,  
(Hae Tibi ERUNT artes) pacique imponere morem,  
Parcere subjectis & debellare superbos.*

*But the Art of Mining, and its many subordinate branches, are in Germany, and its dependent countries, for various reasons, so highly improved, that for these last ages Germany has been justly considered as the most ancient and best school for miners. Though Tacitus, in his romantic account of Germany, told the Romans, that the Gods, either by a providential care, or by their dislike of the nation, seemed to have left the Germans unprovided with mines and metals,*  
or



*or rather to have kept them till then unacquainted with their use and science; things have, however, since wondrously changed, both in respect to the mines, and in respect of their science. The greatest and richest chains and tracts of metallic mountains, which justly may be ranked with those in Peru and in Hungary, have been discovered there in a very remote antiquity, when the other kingdoms of Europe had scarce any idea of that kind of inland riches; and there have been ever since, and there are more mines and mountains yet actually working in Germany alone, than perhaps in all the other parts of Europe put together. Some mines on the Rhine and Danube, in Lorrain, Alsace, Brisgow, Suevia, and the ancient Noricum, seem to have been worked already in the decline of the ancient Roman empire. Many in the interior parts are reported to have been opened under the race of Charlemain. The mines in the Rammelsberg near Goslar, and some of the adjacent ones in the Harz-mountains, belonging to the Electorate of Hanover and the Duchy of Brunswick, are fairly proved to have been discovered and worked to advantage as early as the middle of the tenth century (between A. C. 950. and 1000.) And the discovery of those in Hassia, Misnia, Silesia, Moravia, Franconia, Tyrol, Steyermark, Carinthia, and Carniola, cannot be supposed to have been much posterior in time to that of the former.*

*To judge by the technical language of the German miners, washers, assayers, and melters, they do not seem to have learnt, or had their different arts from the Romans, or other foreign nations. It is downright German. It proves at least what I have shortly hinted before, that these arts are of very old standing in Germany; and as it is very compleat in every respect, and almost the same in the most distant provinces of Germany, it proves, that for a long series of ages these various arts have never been discontinued, and on that account they may be considered as national. Being by their very object and remarkable success naturally recommended to despotic Sovereigns, they have been very early favoured and taken notice of by the many legislators of Germany; and it must be owned, that the metallic general and particular laws of Germany, having been soon refined, have greatly contributed to keep these mining arts alive, by keeping the above mining countries in uninterrupted successful employment. And happy has it proved for Germany, as the inland parts of that extensive and populous country, without the working of these numerous mines, must have lost thousands of unemployed hands, and stand worse in the balance of trade than it hitherto is found to do. The mathematicks, mechanicks, hydraulicks, and the principles of chemistry, have been pretty early applied in Germany, to the traditional and empirical art of mining, as*  
every



every one may judge by the valuable writings of Georg. Agricola, (born 1494—1555) that excellent author of immense and practical erudition, who for these last 250 years has stood unparalleled and foremost amongst the classical authors on mining; and as during these last 300 years, Germany has produced a Copernicus, Purbach, Kepler, Sturmius, Leibnitz, Wolf, Kaestner, Meyer, Segner, Euler, Lambert; Albertus Magnus, (born 1193—1280) Paracelsus Theophrastus, (born 1493—1541) Sennert, Beccher, Kunckel, Stahl, Glauber, Hofmann, Juncker, Vogel, Marggraf, Model, Newmann, Cartheuser, Ercker, Cramer, Schlütter, Gellert, Lehmann, Poerner, Pott, Gerhard, Justi, Waiz, Spielmann, and Meyer,—besides many other unmonumented but great names in the history of mathematicks and of chemistry; it is not without some justice that foreign nations have considered the Germans as their masters in the art of mining, and not without some good reason, that the Germans have first endeavoured in their writings and academies to give this art that scientific form which it is capable of, and to keep pace in it with the English, Swedes, Italians, and French, who of late have begun successfully to emulate their example.

The object of this art is,

1. The working and building of the mines in which they are found;

2. Their

2. *Their extraction and separation from the ores and substances in which they are involved and mineralized; and*

3. *The investigation of fossil and metallic substances or ores.*

*Accordingly it is established upon different sciences, and may be divided into different parts.*

I. *The Art of working and building the Mines consists of a skilful application of natural philosophy and the mathematicks to this particular object; it is therefore to be divided into the following subordinate parts:*

a. *The art of surveying and drawing mines.*

b. *The art of breaking and blasting the rocks and veins.*

c. *The art of timbering and building the works under ground.*

d. *The art of correcting the air, which under ground, for many reasons, is liable to be damp, and unfit for respiration.*

e. *The art of hydraulicks. And,*

f. *At last, the art of mechanicks, for draining the mines of the subterraneous water, and for clearing them from the rubbish or ore by the various forces of nature, or various engines.*

*The old Egyptians, Greeks, and Romans, must be allowed to have not been deficient in these mathematical parts of the art of mining. Many of their subterraneous*



*aneous buildings yet extant, and many of their great works of architecture, which ever will be objects of intelligent admiration, prove it beyond exception, and give credit to the ingenuity of their engines, which certainly we know but very imperfectly by their own written accounts. It would be extremely unfair to suppose that they had no engines; and that, unconcerned about the wretchedness of sentenced slaves, whom they employed in the mines as many Europeans employ the unsentenced innocent blacks, they left them unassisted by their ingenuity to every danger and hardship, which of course must befall the workmen, if they are led in the dark without intelligent guides, and condemned to do the various hard business of the mines by the strength of their hands, which we scarce are able to perform with the animated powers of nature enslaved by art. For unprejudiced mathematicians, or for intelligent antiquarians, it would be no hard task even yet to determine what degree of perfection they had actually attained in the above mathematical arts of mining. The Cloaca Maxima at Rome; the Emissario of the Lago Albano at Castel Gandolfo; their various aqueducts and cisterns; their colossal granite Obelisks cut in Upper Egypt, and thence transported as far as Rome; some mines in Transylvania supposed to be Roman works, and the watering engines, ever since the most distant antiquity, used in Egypt, would by*  
an

*an analytical examination, do justice to their ingenuity and unconquered spirit. But however astonishing they may appear to us in their works, and in the accounts and writings of Archimedes and Euclid, who would seriously pretend that the modern invention of the magnetical needle has not made the art of surveying under ground actually more certain and more easy than it was before? Who can deny, that the modern invention of gunpowder, and the art of blasting, has made us their masters? These powers of nature, which respectively lead us under ground, and arm us with the earthshaking strength of Pluto and Neptune, were absolutely unknown to them. So were perhaps our various drawing and pump-mills, and our ventilators; so was the fire-engine, which is one of the most glorious monuments of English ingenuity, as, independent of the known powers of nature, it goes by a very active principle, in all the former ages scarce so much as noticed.*

II. *The art of extracting and separating the Metals, from the various heterogeneous substances, in which they are contained and mineralized, is carried on by water and fire, or by washers and smelters. It is therefore to be divided into the following subordinate arts:*

a. *The art of pounding the ores in mills.*

b. *The art of washing them.*

b

c. *The*



c. *The art of metallurgy, which, by the agents of fire and acids, separates, purifies, and respectively produces and destroys those various metallic and mineral substances, which are contained in the ores and fossil bodies, and are subservient and necessary to so many wants of human society.*

d. *The Art of assaying or docimasy, is rather a part of metallurgy, teaching, by small and nice assays of acids, fire, and weight, to determine the value, mixture, contents, and nature of the raw ores, or of the metals and mineral substances, produced by the greater operations of metallurgical furnaces and manufactories.*

*If the Ancients, especially the Egyptians, Greeks, and Romans, must be allowed to have been pretty good empirical metallurgists and smelters, as plainly appears by many of their works and accounts, it must, however, be allowed on the other side, that they have not left us any other, but perhaps a few traditional practices and processes, which, in respect to metallurgy and chemistry, are more vague and less to be depended upon, than in other more determined and evident arts and sciences. We can make but very little of their Hermes and Theophrastus, and they had no Archimedes or Euclid for chemistry; nor did they make use of it either in the preparation of their medicines, or in the examination of the elementary substances of nature. Their medicines were mixtures or decoctions*

*decoctions of gross simples and substances, such as the vegetable, animal, and mineral kingdoms offered them; and their natural philosophy was, in respect to the elementary parts, but an ingenious guessing and reasoning in the dark, as it ever has been, and must be, without the assistance of chemistry, which resolves nature into its elements, and by acquainting us with many of their properties, unobservable and unobserved in their former combination, teaches how to make use of them, either in their concentrated simplified state, or in their new modelled combinations. It is to the Arabians that we are indebted for the advantages which philosophers, physicians, æconomists, and tradesmen, have reaped, and may reap, from this science, or rather from that scientific chemistry, which we are at present possessed of, and have so much improved. Many of its technical names and its usual characters would prove it, if the writings of Geber, Rhazes, and many others, had left us any doubt. We must not, however, deprive our ancestors in Germany or England of their claim to the invention or use of more ancient metallurgical processes. I have mentioned already, that the discovery and working of the mines at Goslar falls between the years 950 and 1000, after the age of Geber and Rhazes, who lived in the seventh and tenth century, but before the introduction of Arabian learning in Europe, which coincides with the crusades,*



*and, to our knowledge, has produced no European chemists but in the beginning of the thirteenth century, when Albertus Magnus, or Albert von Bollstaedt, (born 1193—1280) and Roger Bacon (born 1214—1294) appeared. The metallurgical operations at Goslar seem, therefore, in those earlier times, to have been established upon traditional processes, which were either Roman or German; and as, on account of the mixed iron and zincous refractory ores, these operations, though ever so much improved at present, are extremely various, compound, hard, and tedious, there is good reason to suppose, that even the traditional and empirical science of the ancient German metallurgists was by no means inconsiderable. We have scarce any credible account that this traditional art should have been properly fixed for posterity, established upon scientific principles, and remarkably improved by chemistry, earlier than the times of George Agricola, (1555) who for his valuable books *De Natura Fossilium* and *De Re Metallica*, deserves to be called the father of those many excellent chemical metallurgists whom Germany and other countries have produced ever since. I will not enlarge upon the dates and respective merits of Agricola, Encelius, Erker, Becker, Stahl, Schlütter, Cramer, Gellert, Lehman, Vogel, Justi, Henckel, Pott, Marggraf, and others; nor upon their many excellent disciples in Sweden, France,*

*France, and England, such as Bacon, Rob. Boyle, Barba, Hellot, Macquer, Blake, Lewis, Woulfe, Beaumé, Sage, and others; but I beg leave to observe, that metallurgy, being, upon the whole, and for the practical uses of the smelters, reduced upon pretty evident principles, is however very far from having attained its highest degree of perfection in respect to philosophical chemistry. Many mineral substances, ores, and fossils, are still very problematical; but the general spirit of enquiry spread over Europe bids fair to improve it in a quite different ratio from that in which it proceeded formerly. Mr. Cramer's new metallurgy, and Mr. Delius's proposals for copper-refining in Hungary, inserted in this publication, prove, that many metallurgical operations are capable of improvement by the principles of chemistry, duly applied; and the very principles of chemistry are at the eve of being better ascertained, and of being considered in a new light. At least very promising prospects have opened within these few years from Dr. Priestley's late experiments on air, and from the ingenuity and sagacity of Mess. Pott and Marggraf at Berlin, and of Mr. Beaumé and Mr. Sage at Paris. The former have seemingly acquainted us with new qualities and new sorts of air; but, properly speaking, they have exhibited to us only the phænomena of a new, active, subtile, elastic, and powerful solvent or menstruum hitherto not at all, or but imperfectly, made*



use of in our chemical analyses and assays. However, they must of course continue to enrich chemistry, and its dependent arts, sciences, and trades, with many valuable discoveries. I am confident the same must be the case with Mr. Sage's late and very ingenious theory and experiments on mineralization, which being above the understanding, or against the traditional creed of many chemical Virtuosi, have opened in France a new and ample field of abuse, and every where else an ample field of speculation, and of discoveries. It is with the new principles and discoveries in natural philosophy exactly as with the nostrums in physic. At first they are good for every thing; soon after old Method cries them down as good for nothing; but experience proves them at last to be good for something.

III. *The Art of investigating, discovering, and pursuing the metallic and mineral substances under ground, is upon such terms as allow some hopes of establishing it upon certain principles.*

Baron Pabst v. Ohain's idea of a subterranean geography, seems to imply that he thought of it; and the mineralogical accounts of Mess. Ferber, Baron Born, and others, prove to me, that such an art may be invented, and likewise that its invention is in some forwardness,

I shall not speak of Chance, that great discoverer of mines, formerly worked and yet working; nor  
shall

*shall I enlarge upon the virgula divinatoria, or divining rod, tried by philosophers in England, even so late as the times of Robert Boyle, and not an hundred years ago seriously applied in France for the discovering of mines, treasures, wells, robbers, and murtherers. We do not know how to methodize the former, and we are fully convinced that the latter has never answered any purpose but that of making dupes. They are, therefore, best left and recommended to ignorant people, who delight in darkness visible.*

*The only principles, upon which this very interesting art may and must be established, are Mineralogy and Oryctology.*

*Mineralogy, or a sufficient historical knowledge of the fossil bodies, is of absolute necessity to the miner and to the learned. It acquaints the former with the name, form, colour, texture, appearance, value, and other properties of the fossils, and it makes science intelligible by scientific, determined names of their characteristic properties. For want of this science, quantities of rich ores and fossil substances have been formerly thrown amongst the rubbish of the bingsteads; and there is scarce a mining country in which they have not some time or other paved their highways with stones and rocks of value. I know, from very respectable authority, that that was formerly the case of the Cobalt-ores in Hesse, which at*



*present produce an annual revenue of about 14,000*l.* clear of expences. That the deficiency of languages in that part of the art of mining, which treats of fossils, has been hitherto a great obstruction to its improvement, will not be denied, and has been severely felt by every one who wishes to instruct, or to be instructed, in mining, metallurgy, chemistry, and natural history. Only a very few fossil substances have determined names in common life, and in the languages of the politest nations. Such are the purer and finer metals, some salts, and some stones. The infinite variety of their mixtures, different state, mineralization, chemical properties and affinities of their colour, form, hardness, weight, situation, native place and origin, if understood or noticed by the miners and metallurgists, are expressed either by technical or by provincial names, which, to the generality of men, or to foreigners, are what formerly the Greek was to the Monks. I beg leave to observe, that they have not been hitherto taken sufficient notice of in those numerous mineralogical systems, which have appeared these last fifty years. Their authors consider mineralogy under too confined points of view; and many of them have indulged themselves in new and very often arbitrary names and idle classifications; so that an egregious and nearly Babylonian confusion has been added to the old deficiency of languages; and that science, upon the whole, has been less benefitted by*

*them*

*them than justly might have been expected. It must be acknowledged, however, that the chemical classification, and the nomenclature of fossils, introduced into mineralogy ever since the first appearance of Pott's Lithogenesy, and the systems of Wallerius and Cronstedt, have been great advantages to science. Being established upon their constituent parts, and upon reality, they may, under certain allowances, prevent further obscurity and confusion, and perfectly answer the views of chemists and metallurgists. But as they stand at present, can they fully answer the expectation of miners, of natural philosophers, and of friends to science? They must be the basis of mineralogy; no competent judge, and no man of sense, will dispute it; but to benefit the miner, they should be explained in his own technical or provincial language, which is generally neglected; and to satisfy the natural philosopher, they should be established only upon evident principles of chemistry, and never presume to classify fossil substances, which are not hitherto sufficiently examined. Moreover, many fossils are so compound in their mixtures, that a chemist may make any thing of them; and most part of their chemical characters are so far abstruse and obscure, as they relate rather to a future state than to that raw and natural one, in which we see and discover them. A chemical mineralogist will at most tell you what fossils are good for, or what you may make of them,*



*them, or of what they are composed. He will thence make you guess likewise by what natural operations they may have received that raw and natural form in which we find them. But fire, crucibles, retorts, alembics, acids, and touchstones, are insufficient to teach with certainty by what natural operations they really were produced. These are facts, which chemical principles and good reasoning will and must explain; their reality must be ascertained by historical evidence, or by ocular inspection and experiment, for the same mixture of fossils can be produced by fire and by water, by melting and by solution, by sublimation, by precipitation, and by other operations. This we plainly experience in our laboratories; and as these operations are really different from each other, and generally productive of particular forms and circumstances; it is but just to suppose, that the same or similar, operations in the great laboratories of Nature, are and must be productive of similar forms and circumstances, and that the particular forms and circumstances in which the fossils are found, should be nicely noticed by mineralogists, who pretend to give full information and adequate ideas. They must henceforth examine, rank, and describe them not only as individual substances by their chemical properties, colour, texture, and form, but they must consider them likewise under the more extensive point of view of their former natural situation, stratification,*

tion, connection, and vicinity with other fossils in the native places, beds, and veins in which they are found. By so doing, mineralogy receives a latitude, of which it hitherto has been deprived; fossils appear in their only and true natural order, which is that of their chemical properties and of their natural situation; the fossil beds and veins become monuments of former revolutions, or of natural chemical operations; and, in short, the art of discovering or pursuing them under ground will be reduced into probable rules. I do not indulge a chimerical fondness for a favourite idea. I have traced the outline of a mineralogical system upon these principles; that is to say, a system which goes hand in hand with the principles of chemistry and of stratification; and I must be false to truth, if, for an ill-placed bashfulness and modesty, I should not publicly acknowledge and recommend its advantages. Hints of this new mineralogy are thrown out in my account of the German volcanoes, and especially in my preface and index to Ferber's Letters on Italy, and to this publication. I hope they will suffice for the intelligent, and make good the assertion, "that the invention of the art of discovering mines is in good forwardness."

Philosophers, ancient and modern, have hitherto considered mountains in general from a point of view which was too confined, or entirely different from  
that



*that of mineralogy and mining. For being unimproved by the light of volcanoes, and by that extensive knowledge which they might have reaped in the deepest mines of the highest mountains, and from the instruction of unscientific miners, they stuck only to their libraries, and to the uppermost crust of the earth, which, without any great trouble to themselves, they had an opportunity of examining in the most pleasing countries, and in the most superficial quarries of sand-stone, limestone, and slate. We are not to wonder, therefore, that orology, or the science of mountains, is so little understood amongst the learned; and that the descriptions of the higher mountains in Peru, Teneriffa, Switzerland, and different parts of Europe are generally filled with meteorological observations, botany, and other accounts, which leave their very nature in a mineralogical and orological respect full as unknown as they were before. The consequence was plain; that general conclusions have been too rashly drawn from a single kind of mountains, and that the pretended systems of the origin of the mountains in general are, for the greater part, so very romantic and superficial.*

*Experience and history prove the mountains and strata of the earth to be of a very different nature, origin, and antiquity. They have been accordingly divided by Mr. Giovanni Arduino, at Venice, into primitive, secondary, modern, (Tertiarii) and volcanic mountains. I shall not repeat from Mr. Ferber's Letters*  
what

what characters he has given of these various mountains; but I must notice, that primitive mountains, or strata, have been spoken of very early by other philosophers, and that they are generally understood to consist of simple rocks, less stratified than the incumbent strata, and never containing in their paste and mixture any petrefactions, of adventitious, organic bodies of shells, other animals or plants. That there are such mountains and strata, is unquestionable, because they are found either at the bottom of the deepest mines, or bare appearing through a variety of incumbent other strata at the summits of the higher mountains. But it would be extremely presumptuous to insist upon their being true primitive mountains. The only consequence which fairly can be drawn from Mr. Ferber's and Mr. Arduini's Observations in his *Raccolta di Memorie Chimico-mineralogiche: Venezia 1775*) is, that the reddish granite (*granito rosso d'Egitto*) and the micaceous and horn-slate, for being every where found below a variety of other incumbent strata, must, in respect to time and origin, be anterior and different from them, and that, for this reason, they may justly be called the most antient rocks hitherto known.

The secondary strata and mountains, chiefly consisting of limestone and argillaceous slate, are accumulated on the former, and the more modern ones are incumbent on these. They owe their origin to a  
variety



*variety of causes and accidents, as may be proved even by history. Nor are even the volcanic mountains and strata produced by and under the same circumstances. as sufficiently is hinted by me in the preface to Ferber's Letters, and in my account of the German volcanoes. Of course they must all of them, for chemical and historical reasons, offer a variety of circumstances in the form, mixture, and substance of their paste and rocks, in the situation of their strata, in the nature and direction of their veins, and in the nature and mixture of the parasitical rocks, which are produced in their veins and caverns.*

*The miners in Germany, whose ideas have been generally confined to their main object, and to the nature of the mountains, in which they worked, have, instead of the above division of the mountains, divided them into flat and into gang mountains. (Flots, and gang-gebürge.)*

*By the former they understand stratified modern mountains, which generally surround the higher and more ancient ones, and are worked not for their veins, but for the contents of their strata, which are less dipping, and more horizontal, than those in the higher mountains. Such are the slate copper-works in Mansfield, the coal mines in general, and many iron mines.*

*By gang-mountains, they understand higher metallic mountains, which are working for their veins or stocks, and consist in Germany, Bohemia, and Hungary,*

*gary, of granite or micaceous and horn slate, or of what naturalists would call primitive mountains. By gang, or gang-geburge, they understand likewise those various substances which either do never appear in stratified rocks, but in veins (or gaengen) only, viz. the whole tribe of parasitical stones, of quartz, spar, fluor, &c. or those, which in particular cases are found to fill veins, joints, and stocks, as granite, slate, zinnopel, grit, clay, and other matrices of metals and minerals. In this sense, it is used to distinguish them from the rocks of the mountain on both sides of the vein or stock; and it is absolutely a relative denomination, since the same substance may be in some places particular to the vein, and in some others to the mountain.*

*Father George Agricola is undoubtedly the first, and, I dare say, till of very late, unparalleled in respect to some scientific knowledge of the veins, their run, and their rules. What he knew and drew of it, he knew from the miners; but as ever since they have scarce been consulted at all, by philosophers who attempted to create and to dream mountains and worlds, and systems of mountains and worlds, it is no wonder that hitherto the learned should have so little added to that stock of science, which he has left us. The best general accounts, besides his, are Lehman's two German Treatises on the Flat Mountains and the Metallic Matrices, and some general principles in those valuable elements of the art of mining,*  
*which*



*which have been published by the academy for miners since 1765, established at Freiberg in Saxony. But we are very far from being thoroughly acquainted with their nature. We know them only by a few good observations made in Germany, Sweden, and Hungary. By these it appears*

I. *That the veins of the same mountain, nay, of very extensive tracts of land, are subject to the same rules in respect to their direction, dipping and cross-joints, and of the same nature in respect to their contents, ores and fossils.*

II. *That veins of the same mountain, running in the same direction, and through and under the same rocks, are loaded with the same ores and fossils; and accordingly seem to have been produced and loaded by the same natural revolution.*

III. *That those which cross them in contrary directions, seem very often to have been produced in different times, and by different revolutions, when they are loaded with different substances.*

IV. *That the veins of the incumbent mountains, for example, of calcareous or slate mountains, have their particular rule of direction, dipping, cross-joints, and contents, very often unaffected by the different rule of those veins, which are in the lower rocks of slate or granite; whence it appears, that these latter were, in point of time, anterior to the former.*

V. *That*

V. *That the veins commonly turn quicker and richest in the crossings.*

VI. *That ores and metals are produced in the crossings, which did not appear before either in the main vein, or in the cross-joints.*

VII. *That they are generally quick when running or dipping along, and between the limits of different adjacent or incumbent rocks; for example, in the limits of granite and incumbent slate, or in those of slate and incumbent limestone.*

VIII. *That their contents or loads of rocks, parasitical stones, ores, and metals, generally have a natural and chemical relation to the rocks in and under which they are running; that is to say, that veins in granite carry tin, wolfram, pyrites, black-lead, quartz, and granite grit; that veins in limestone carry spar and fluor, besides lead and other metals; that veins in the Hungarian metallic rock are filled with quartz, feldspath, gold and silver; that veins in hornstone produce gold, silver, and zin-nopel; that veins in slate are loaded with argillaceous substances, quartz, silver, lead, copper, and iron; and that the natural productions of limestone, slate, porphyry, trapp, and volcanic beds, if incumbent on deeper veins, appear in them, or produce modifications of fossils, which their own matrix, rocks, or sides, would*



*not have produced by themselves. To verify these assertions, I refer the intelligent reader to a tabellary abstract of some mines described in this publication, and beg leave to observe, that, by similar abstracts of all the good mineralogical and orological accounts which are come to my hands, I am enabled to give in a new edition of my System of the Earth, something more satisfactory about orology and the metallic mines in general than hitherto has been given to the public. They are the work of many years, and of great labour; and with the various improvements of the above System, not undeserving that generous support and encouragement which, though a foreigner, I make bold to expect from unprejudiced friends of science, and from those gentlemen, whose interest and business it is to see somewhat clear under their own ground, and to prevent those many impositions and disappointments, to which adventurous, unprincipled miners are subject.*

I. *This System of the Earth and Mountains is to appear in two volumes in 4to. and to contain*

II. *An exact description of the surface of the earth and its strata; with an appendix of my own, and various of the best orological observations reduced into tabellary forms.*

III. *Hif-*

III. *Authenticated accounts of the various revolutions which have produced, changed, and affected the mountains, strata, and veins.*

IV. *Candid and literary accounts of the best orological systems, especially of that of the Greeks, and of the late Robert Hooke, who did not live to give it its due extent.*

V. *A short explication of the phænomena on the surface of the earth, by the above historical accounts, supported by the principles of chemistry.*

VI. *An ample sketch of a new system of mineralogy for miners, laid down upon the principles of metallurgy and stratification, with a constant reference to the technical and provincial language of the miners and smelters.*

VII. *Some scientific sections, plans, and maps, beside some instructive and ornamental drawings of unnoticed fossils and petrifications, will be added; and as I must be at the expence of some enquiries in the mining countries of Great Britain and Ireland before I can put the last hand to the work, which will not be without some expence, I desire the friends of science to take this work under their protection, to leave their names and orders at Mr. George Kearsley's, bookseller, in Fleet-street; who likewise will take care of their commands and enquiries, directed to me, in*



whatever I may be useful to them. More particular proposals will be published as soon as the subscribed or ordered copies amount to a certain number. Meanwhile

Current utiliter mei  
Nullo cum strepitu dies ;

and I shall continue the publication of other valuable mineralogical and orological tracts, which, for the better convenience of the purchasers, will appear in the same form as this, and as Ferber's Letters. In the next I intend to lay before the English public

1. Supplements to the Mineralogical Letters of Baron Born, taken from an improved edition, which lately has appeared in Germany.
2. Abstracts from Gio. Arduino's *Raccolta di Memorie Chimico-mineralogiche, Metallurgiche e Orittografiche*, published in 1775 at Venice.
3. Ferber's *Accounts of the Mines in Derbyshire*, published in 1776 in Germany.
4. Ferber's *Accounts of the Mines in the Palatinate*.
5. Ab-

5. *Abstracts from Mr. Colini's Mineralogical Travels in the Palatinate; reserving for other future publications the best mineralogical accounts of the mines in the Harzforest, Saxonia, Hesse, Tyrol, Sweden, and Italy.*

R. E. R A S P E.

London, Sept. 1776.

P. S. *The ounce spoken of in this publication is equal to one half ounce English, and the annexed orological tables are given only as essay, not as compleat abstracts of the accounts contained in this volume. Moreover I beg to observe, that the smallness of the size would not allow to specify the different species of ore, nor to give some other minute details. Sed sapienti fai!*





A P P E N D I X  
TO THE  
P R E F A C E,  
OROLOGICAL TABLES  
OF SOME  
M I N E S  
DESCRIBED IN  
FERBER'S LETTERS  
FROM  
I T A L Y,  
AND IN THIS  
P U B L I C A T I O N.

Those of the MINES at JOACHIMSTHAL, in  
Bohemia, to be compared with the MAP.



<i>Name of the Place and Mine.</i>	<i>Mountain, or Sides of the Vein.</i>	<i>Rock.</i>	<i>V E I N. Ore.</i>	<i>Direction.</i>	<i>Dipping.</i>
<i>Faistriz</i> , near Pegaw, in Steyer- mark. Ferber's Ital.	Limestone blue argil- laceous slate.	Spar and quartz.	Leadglance, with silver.		
<i>Idria</i> , in Crain. Ferb. Ital. Lett.	Limestone blue arg. slate.	Slate.	Cinnabar and quick- silver.		
<i>Feltrino</i> . Ferb.	Limestone slate.		Quicksilver.		
<i>Schio</i> , in Monte Trifa. Ferb.	Limestone alternating with vol- canic fra- ta.	Spar.	Silver, lead, copper, manga- nese.		
<i>Valle di Gor- no</i> , in Ber- gamasco. Ferb.	Limestone and lava.		Lead and blende.		
<i>Montieri</i> . Ferb.	Limestone and slate.	Spar and quartz.	Silver, lead, copper, iron.		

CROSS VEINS, *or*

IMPROVING.

CUTTING OF, OR STRIKING DEAF.

[illegible]



<i>Name of the Place and Mine.</i>	<i>Mountain, or Sides of the Vein.</i>	<i>Rock.</i>	<i>V E I N. Ore.</i>	<i>Direction.</i>	<i>Dipping.</i>
<i>Nagyag. Born.</i>	Red clay, sandstone, metallic rock.	Feldspath and fat quartz.	Gold and fil- ver mine- ralized; auriferous antimony; arsenic; cinnabar.	South to North. All the quick veins, pa- rallel.	West to East.
<i>Toplitza. Born.</i>	Clay slate, metallic rock.	Quartz.	Gold, red fil- ver ore, lead.	South to North.	
<i>Fuezes. Born.</i>	Clay slate, metallic rock.	Quartz.	Gold.	South to North.	
<i>Felfo Banya. Born.</i>					
<i>Borkul mine.</i>	Hornstone.	Zinnopel.	Gold and fil- ver.		
<i>Great Mine.</i>	Hornstone and metal- lic rock.	Zinnopel.	Gold and fil- ver.		
<i>Smolnix. Born.</i>	Micaceous and blue slate.	Clay and quartz.	Copper py- rites, and silver.	East to West in hour 6. Three quick veins pa- rallel.	In 75 degree.

# CROSS VEINS, or CROSS JOINTS.

## IMPROVING.

Rock.	Ore.	Direction	Dipping.
Quartz & fluor.	Sulphur, antimony, manganese.	In the hanging.	In 75'. East to West. Bring the veins in the hanging, and quicken them.

## CUTTING OF, OR STRIKING DEAF.

Rock.	Ore.	Direction.	Dipping.
		In the hanging, crossing the main vein in an acute angle.	West to South in hour 9, or hour 21. West to East, or to North. Bring the veins in the hanging, and strike them deaf.



<i>Name of the Place and Mine.</i>	<i>Mountain, or Sides of the Vein.</i>	<i>Rock.</i>	<i>V E I N. Ore.</i>	<i>Direction.</i>	<i>Dipping.</i>
<i>Stemnitz. Born. (Spitaler Vein.</i>	Clay slate, metallic rock.	Quartz and zinnopel.	Gold, silver, lead.	North to South, or South to North, be- tween hour 12 and 4.	West to East, between 30' and 70'.
<i>S. John's.</i>	Metallic rock.	White clay and quartz in the hanging; zinnopel in the hading	Silver.	In the hang- ing of the former; and pa- rallel.	
<i>Beaverstoln.</i>	Metallic rock.	Quartz, zin- nopel, spar	Gold, silver, lead.	North to South as above, be- tween 12 and 4.	West to East, be- tween 30' and 70'.
<i>Theresia.</i>	Metallic rock.	Zinnopel.	Gold, silver, lead.	North to South.	East to West; then ver- tical; at last West to East.
<i>Catharina- berg, in Bohemia. Ferber.</i>	Gneiss.	Gneiss or grit of granite.	Silver, cop- per; mi- neralized and native.	South to North, or North to South, in hour 2.	Between 60' and 90'.
<i>Pressnitz. Ferb. Maria Kirchbaw.</i>	Gneiss.	Gypseous spar.	Silver.	North to South, in hour 12 and 1.	

CROSS VEINS, *or* CROSS JOINTS.

IMPROVING.

CUTTING OF, OR STRIKING DEAF.

Rock.	Ore.	Direction	Dipping.	Rock.	Ore.	Direction.	Dipping.
White clay, spar, quartz.	Silver.	In the hanging					
White clay, quartz, spar		East to West.		Coarse clay, spar			
Quicken the veins.							



Name of the Place and Mines.	Mountain, or Sides of the Vein.	Rock.	V E I N.			Dipping.
			Ore.	Direction.		
JOACHIMSTHAL, in Bohemia						
1, Gold- rose hading	Slate, grey micaceous	Clay; red hornstone or flint; clay slate; spar; quartz.	Silver, lead, cobalt, ar- senic: rich ores.	South to North, h. 1. $6\frac{1}{4}$ p	East to West, between 54' 78'.	
2, Gold- rose hang- ing.	Ditto.			h. 12. $5\frac{1}{2}$ .	Ditto.	
3, Fund- grub.	Ditto.	Ditto.	Ditto.	h. 12. $6\frac{1}{2}$ .	Ditto.	
4, Baker's Vein.	Ditto.	Ditto.	Ditto.	h. 7. $7\frac{1}{2}$ .	Ditto.	
5, Gefhi- eber.	Ditto.	Ditto.	Ditto, silver native: in the cross	h. 10. 4 p.	Ditto.	
6, Rose from Jericho	Ditto.	Ditto, and red spar, in the cross.	Ditto, and glass and red silver ore: in the cross.	h. 2. 3 p.	Ditto.	
6, Sweit- zer.	Ditto.	Ditto.	Ditto.	h. 1. $2\frac{1}{4}$ .	Ditto.	
7, Young Sweit- zer.	Ditto.	Ditto.	Ditto, and native fil- ver and glass ore N. B. The ores, and the richer ones. chiefly in the crosses of the following Eastern veins.	h. 2. $4\frac{1}{4}$ .		

NORTHERN VEINS.

# CROSS VEINS, or CROSS JOINTS.

## IMPROVING.

## CUTTING OF, OR STRIKING DEAF.

Rock.	Ore.	Direction.	Dipping	Rock.	Ore.	Direction.	Dipping.
Trapp.		East to West.	South to North				
Trapp.		Ditto.	Ditto.				
Trapp.		Ditto.	Ditto.				
Porphyry, fat clay.		South to North					
All the above Northern veins are besides constantly improved by the crossings of the Eastern ones, which run from East to West.				Porphyry		South to North.	
				Porphyry		South to North	



	V E I N.					
	<i>Names of the Place and Mine.</i>	<i>Mountain, or Sides of the Vein.</i>	<i>Rock.</i>	<i>Ore.</i>	<i>Direction.</i>	<i>Dipping.</i>
E A S T E R N V E I N S.	<i>Joachimsthal, in Bohemia</i>					
	1, Lawrence.	Slate gray micaceous	Clay, clay slate, spar, and quartz.	Silver, lead, cobalt, arsenic : rich ores.	East to West, h. 5. $1\frac{1}{2}$ p	South to North, between 60. 73'.
	2, Susanna.	Ditto.	Ditto.	Ditto.	h. 6 $\frac{3}{4}$ .	Ditto.
	3, Vrsula	Ditto.	Ditto.	Ditto.	h. 6 $6\frac{1}{4}$ p.	Ditto.
	4, Andreas.	Ditto.	Ditto.	Ditto.	h. 7 $2\frac{1}{4}$ p	Ditto.
	5, Cow Vein.	Ditto.	Ditto.	Ditto, and silver native glass ore, lead-glance.	h. 7.	Ditto.
	6, Rose Vein	Ditto.	Ditto.	Ditto.	h. 6 $\frac{3}{4}$ p	Ditto.
	7, Elias.	Ditto.	Ditto.	Ditto.	h. 7 $\frac{1}{2}$ p	Ditto.
	8, George- stoln.	Ditto.	Ditto.	Ditto.	h. 6 $3\frac{1}{4}$ p.	Ditto.
				N.B. The ores and the richer ones chiefly in the crosses of the above Northern veins.		

CROSS VEINS, *or* CROSS JOINTS.

IMPROVING.

## CUTTING OF, OR STRIKING DEAF.

Rock.	Ore.	Direction	Dipping.	Rock.	Ore.	Direction	Dipping.
				Trapp. Porphyry Trapp.		East to W South to N. South to N.	South to N. } East to W.
				Trapp. Porphyry		East to W South to N	South to N.
				Porphyry.		South to N.	

B. The above Northern veins cross and improve the Eastern ones.

N. B. The above Northern veins cross and improve the Eastern ones.





## T R A V E L S

THROUGH THE BANNAT OF

T E M E S W A R, &amp;c.

L E T T E R I.

*Temeswar, June 14, 1770.*

MY journey from *Shemniz* to this place has scarce offered me any object that might make this letter agreeable to a naturalist of your cast. Had I, besides my little mineralogical science, some knowledge in Botany, my three days travelling over barren heaths from *Ofen* to *Segedin*, and thence to *Temeswar*, might have perhaps procured me an opportunity to entertain you at least with the names and descriptions of some plants. But alas! I am no Botanist, tho' that is not my fault. You well know how fond I am of natural history. But I never met with any proper opportunity

B tunity



tunity to improve in this part of science. Except at *Vienna*, there is no academy in all the *Austrian* states, in which Botany is taught; nay, even at *Vienna*, there is no Professor of Natural History. For this reason you need not be astonished that natural history is entirely unnoticed and neglected in *Austria*, while the *English*, *French*, *Swedes* and *Russians*, for the sake of useful science, examine their own and the remotest countries of the world. But to what purpose these complaints? You may guess by them the dissatisfaction, which will attend me on my journey through the mountains of *Bannat*, *Transylvania*, and part of the *Carpathian hills*. All the riches of *Flora*, during the finest season of the year, displayed in these parts, will be scarce at all enjoyed by me. However, I do what I am able to do, and I repeat my former promises, that you shall have a share of the minerals which I collect, and accounts of the nature of the mountains, and the working of the mines, which perhaps may be new to you.

From *Shemniz* to *Ofen*, the mountains consist of the same argillaceous rock, which is mixed with quartz, fherl and mica, and composes the whole mass of mountains about *Kremniz* and *Shemniz*. In some places, and especially at *Deutsch-Pilsen*, they have likewise discovered some copper and silver-veins, drained some old and drove some  
new

new galleries ; but to no great advantage. All these mountains are covered with argillaceous slate and limestone.

Near *Waizen*, a handsome little city on the *Danube*, begins the plain, which uninterruptedly stretches thence to *Temeswar*, and to the left hand to *Debreczin*, and the limits of *Transsylvania*. In three hours I came to

*Pest*, where I spent a day. This city, adorned with magnificent structures in the newest taste, is entirely built of petrifications. The quarry, whence they fetch the stones, is near *Ofen*, a city directly opposite on the other side of the *Danube*. I examined these calcareous hills, productive of the best wine of *Ofen*. They consist of a porous limestone, which is filled with innumerable quantities of chamites, turbinites and pectinities. Our *Walch's*, *Schrotters* and *Hupfches*, with several other gentlemen of that kind, who are affraid of coal dust, and the horrors of smutty mines, and hunt after petrifications only on the surface of the earth, might in this place make rich crops ; nay, they might perhaps, from this immense stock of shells, pick up some chamites or pectinities, with some unknown undescribed stripes, wrinkles, folds, warts and points ; and then, mercy upon our ears ! how they would indulge themselves in God knows what analogy or similarity ; in forming far fetched

B 2

names,



names, and singing forth the praises of their important discoveries ! To us simple mineralogical folks it is sufficient to have found here marks of an ancient sea's covering this part of *Europe*.

The hot baths at *Ofen* are spoken of by all geographers. Mr. *Laurentius Stocker* describes them at large in his *Thermographia Budensi*. According to his account, their constituent parts are sulphur, lime, and iron.

Beyond *Ofen* begins the famous *Ketskemite-beath*. It is all over covered with grit sand (*glarea Linnaei*) mixed with broken sea shells. The stones which now and then appear straggling, are feruminated by this sand. I travelled often six hours and longer without meeting with any tree or house, except the stage houses. However this plain, fifty *German* miles square, feeds vast quantities of cattle. Near *Debreczin* they dig out of some swampy grounds of this heath the *Sal alcali minerale nativum*, mixed with some clay. For many years they have made of it the excellent *Debreczine* soap, which sells over the whole kingdom. In former times they considered this as a common saliter. Mr. *Stephen Wesszpremi*, a celebrated physician at *Debreczin*, and Mr. *Just John Torkos*, were the first who examined it. The former spoke of it in his

*Tentamine de inoculanda peste. Londini, 1755.*

and

and the latter in his treatise

*De sale minerali alcalino nativo Pannonico. Pofonii,*  
1763.

I heard lately from *Vienna*, that a young physician, Mr. *Gabriel Pazmandi*, from *Comorra* in *Hungary*, has published a new treatise on this salt, its native situation, qualities and powers.

I observed on this heath some flocks of large eagles, and some birds in the swamps, which were unknown to me, and may be perhaps for want of a proper description, or a scientific zoologist to observe them, uninferred and unnoticed in the systematical catalogues of birds.

Beyond the *Theissa* (*Tibiscus*) and as soon as I left *Turkish Canisba*, the soil appeared richer and more entertaining. Here are plantations of trees, corn-fields, and plenty of colonies, whose establishment costs to our imperial queen immense sums annually.

The villages are built upon a regular plan; the houses, for want of wood, built of unbaked bricks, and thatch'd with reed (*arundo*.) They have generally a parson, a school, a corn magazine, and an accountant or inspector. Every colonist receives at his arrival a suitable house, the tools of husbandry, the household implements, some horses, and a piece of ground. After some years he gives the tithe of his crop as a contribution, and



then he may pay every year what he can afford of the whole property.

A good husbandman is sure to prosper here. Perhaps it might have been made more easy to them if the villages had been planned smaller. There are some that contain 3 or 400 houses. As every colonist is possessed of a large waste ground, which he is to cultivate, many of them have an hour's ride before they can reach it.

LETTER

## L E T T E R II.

*Temeswar, June 17, 1770.*

**Y**OU know that two years ago I travelled in this country; besides I was born in *Transsylvania*. I have therefore materials for a letter, which may for the want of natural history, if not please, at least entertain you.

The *Bannat* of *Temeswar* is that tract of land in *Hungary*, which in the *Homannian* maps is found under the title of the *Csanader* or *Temeser* county. It is under the 45th degree northern latitude, is 22 *German* miles in length, and 15 or 16 in breadth. Its boundaries are to the north the river *Maros*, to the west the *Theissa*, to the south the *Darube*, and to the east tremendous chains of rocks, which separate it from *Transsylvania* and the greater *Wallackia*. But on this side it joins to the continent; in respect of the other sides it is a peninsula. It is divided into eleven districts or bailiwicks, viz. that of

*Csanad*, of *Czakova*, of *Szent Andrasb*, of *Szent Miklosb*, of *Beczkerék*, of *Uy Palanka*, of *Vershez*, of *Orsova*, of *Caransebez*, of *Lugosh*, and of *Lippova*. Every district is subdivided into smaller ju-



rifdictions, which are called proceffes. A bailiwick confifts of the bailiff, a comptroller, two or three under bailiffs, a fcrivener, fome advocates and upper-knefes, which are a fort of national magiftrates. All thefe bailiwicks are immediately under the country-adminiftration, and this under the royal court chamber-deputation at *Vienna*. The *Bannat* being a domanial eftate of her majesty, is entirely independent of the *Hungarian* ftates. The chief town and the center of the country is *Temefwar*, a regular, fine, and ftong place, but unwholefome on account of its fwampy fituation. Agues and inflammatory fevers of all kinds rage here every feafon, and procure to the phyficians uninterrupted bufinefs.

Here is the general government, the country adminiftration, the provincial court, the chapter of *Cfanad*, whose bifhop is by his own right *primus inter pares* in this country, and two patentee-commercial companies for the *Austrian* fea-ports in Italy. The whole eastern part of the country is mountainous and beft inhabited; the western part is flat and fwampy. In this are large uncultivated plains, which government takes care to plant with *German* colonies from the *Swabian* and *Rhinifh* circles. On the four corners of the country are fome ftong places, fuch as *Canifha*,  
*Semlin*,

*Semlin, Mehadia, and Lippa. Szegedin and Arrad,* situated on the other side of the *Maros* and *Theissa*, are *Hungarian* dependencies. None of these four places are remarkably strong. However, they are celebrated in the history of the *Turkish* wars, as are likewise *Pansowa, Uy-Palanka, and Orsowa*. The rivers in the *Bannat* are of no importance, as running only through a short tract of land; but the *Temes* and *Nera* deserve notice, the former being made navigable down to *Peterwardein*, by an expensive canal, drawn from *Lugosh* to *Temeswar*.

The soil is extremely fertile. The wine is in many places excellent. It is generally of a red colour. Peach, cherry, and plum trees are very common. Large plantations of that kind skirt the villages and provide the inhabitants with their drink. The silk plantations spread almost over the whole country; they might, like many other manufactories of the bannat, be in a more flourishing state, if that great general and politician Count *Mercy d'Argenteau*, had lived to support them.

Of late there has been raised in this country a national-militia, which in the imperial and royal military state goes under the name of the *Illyrian* regiment. It is commanded by the lieutenant-colonel



colonel Baron *de Sezugas*, knight of the *Theresian-order*, a man who has greatly served his country. Not satisfied to have corrected the rough behaviour of his officers, and to have habituated them to the *German* manners, he endeavours likewise to humanize his private men. He establishes schools and masters, and the foldier is obliged to have his children sent there. If we had a calendar of political saints, Baron *Sezugas* would shine in it, under the title of the *Illyrian Reformer*.

The *Plajasbes* are another sort of national troops, posted on the limits of *Transsylvania* and the greater *Wallackia*, from *Marga* towards *Orsowa*, to put a stop to transmigrations, and to prevent the escape of the *Turkish* and inland robbers. They are under the command of captain *Peter Vansha*, who in the last *Turkish* war was *Haran-bassa*, or chief of a numerous gang of robbers, and deserved his fortune for having in the last war saved the late emperor at *Cornua* from the imminent danger of being taken prisoner by the *Turks*.

This nation is remarkable for having produced many brave men of great desert. Captain *Ducca* for example, a man of eighty years of age, has in the late *Turkish* war been of eminent service to the court; however, he never has solicited or received any preferment, happy in the consciousness  
of

of his honest services, and of his master's grateful disposition. I will in one of my letters describe at large the character, the manners, and the religion of the inhabitants. At present I add only an abstract of my yesterday's transactions and business.

Soon in the morning I was awakened by a dismal and frightful rattling of chains, which sounded all along the street where I have lodgings. It was occasioned by the malefactors, condemned to the fortifications, who, by couples chained together, went to work. I did not see in the streets any but bleak, yellow-coloured, decayed faces, peeping and issuing forth from the finest buildings. The women, even the girls, had thick swollen bellies, left them by the fevers. I fancied myself in the realms of death, inhabited, instead of men, by carcases in fine tombs. At dinner all the guests, besides me and some foreigners, had a fit of their fever; some freezing, gnashed their teeth; some burning for heat, could not assuage their thirst. In the afternoon I visited the canal which I spoke of before. I saw there some hundreds of beehives conveyed to the meadows, and to the heaths, where the bees are left for pasture during the whole summer. Each set of sixty hives has a bee master to take care of them. The hives are constructed  
of



of eleven thin pieces of deal, three inches thick, and at one end decreasing into a point. They are joined by willow or birch branches into a hollow cone, open at the bottom. Two or three inches above the ground there is a small opening, and within some crosses of wood, on which the bees suspend their work. But they behave in *Hungary* with ungrateful cruelty to these laborious insects, since, to take out the honey, they push the hive with violence against the bottom of a tub, which brings down bees, wax and honey in horrid confusion, the whole to be mashed and crushed into a sweet but disgusting mixture.

In the evening I visited the publick goal, where I saw a famous robber, who, during the last summer, had greatly annoyed the *Turks*, and by particular desire of the Grand-Signor is kept here, as they told me, till the end of the war. He is a young, well dress'd, and handsome man. He was formerly a rich merchant in *Servia*, and became a robber to revenge upon the *Turks* some violences which they had offered to him and to his family. His determined, bold, physiognomy, and his rash undertakings, in which he was very successful, raised in me the idea, that perhaps he might have proved an *Alexander*, if he had been born to attempt with greater forces, what he neither

ther dared, nor is any other person permitted to attempt, with smaller ones. All this will easily convince you that my stay in this place cannot be agreeable to me. But the business of my companion layeth me under the necessity to stay some days more. Therefore, if you be happy, remember your friend in *Pontus*.

LETTER



## L E T T E R    III.

*Temeswar, June 20, 1770.*

THE inhabitants of Bannat are *Raizes*, *Wallachians*, and a fourth part *Germans*.

The *Raizes* are said to be originally a *Scythian* people, in former times inhabiting *Dacia*, now called *Servia*. They call themselves *Srbi*. Their language is a corrupt *Sclavonian* or *Illyric* dialect.

The origin of the *Wallachians* is less certain. They call themselves *Romun*, a word which in their language equally signifies a *Roman* and a *remaining man*, and makes it doubtful whether they be remaining parts of *Roman* colonies, or of a people conquered by the *Romans*. The *Roman* medals, tombs, and other monuments, found in the mountainous parts, and near the *Danube*, are valuable evidences of their having been in former times subjects to the *Romans*, either in the one or in the other sense. Even their language, which in greater *Wallackia* (*Zara more*) is spoken very rudely, but in *Transsylvania* (*Ardellia*) has the reputation to be spoken very elegantly, is a corrupt *Latin*. However, I do not conceive how so  
many

many *Italian* words, such as *rame* (copper) *man-gar* (eat) and many more, that have no similarity with the *Latin*, came to be used by them. The termination of their words in general, and the conjugations after the *Italian* manner, have been mixed into the language of this nation.

Their manner of living is extremely rough and savage. They want religion, arts and sciences. Their children are from their first infancy washed every day in the open air, in warm water, and then swathed in coarse linnen or woollen cloth. The difference of the seasons and the weather makes herein no difference. From the fifth to the twelfth or fourteenth year of their age they are left with the herds and flocks to attend them; however, the girls are taught in the same time washing, baking, spinning, making needle-work, weaving, and so on. From the 14th year they are brought up and employed in husbandry. Kukuruz or maiz is their chief object of agriculture. However, they sow likewise oats, barley and corn. They distil from the fruits of trees, which they plant in great plenty, a sort of brandy, called rakie, which they are very fond of. Their meat is as simple as their dress. Bisquet of coarse grinded maiz, baked under ashes, which they call malai, some flesh, milk, cheese, beans and other vegetables, are their common food. Their dress is  
various;



various; but generally it consists of the following articles. The men wear long white woollen trousers, as the *Hungarians*, but wider; soles of raw skin tied about the feet instead of shoes; a shirt open on the breast; a woollen jacket or coat, tight around the waist, with long sleeves, and a fur cap or bonnet for the head. The women have long shirts down to the ancles; a brown variegated striped petticoat open on both sides, and tied with a girdle; a waistcoat or garment of coarse cloth, somewhat shorter than the shirts, and an annular bolster stuffed with hair or straw upon their head, which they cover with a woven cloth. The girls go bare headed. Their ornaments consist of ear-rings of white or yellow brass, of coloured glass, beads, pearls, glass feathers, and pieces of money fastened to a string and tied around the head and the neck. This ornament makes a ringing, so that a fine dressed *Raize*, or *Wallachian* girl, may very often be heard sooner than seen. They marry very young; and there are married couples, the man not above fourteen, the wife even not twelve years of age. Some manual arts seem to be peculiar to them. Scarce any where you will find a cartwright, or a weaver; every *Wallachian* being a cartwright, and every woman a weaver. No woman is seen going about without some work in hand. What they bring to sale they

they carry on their heads. If they have a child to nurse, it is carried in the same manner. The spindle is sticking in their girdle, and all the way they are spinning. All their necessaries are worked up by themselves. Scarce any tradesmen nor any beggars are seen among them. What can I say to you of their religion? They confess the non-united *Greek* religion, *Græci ritus non unitorum*. But in fact they have scarce more religion than their domestic animals, except repeated fastings, which almost take up half the year, and are so extremely severe, that they dare not eat any meat, eggs, or milk; they scarce have any idea of other religious duties. But in these fastings they are so scrupulous, that they do not break them, even should they slight every other divine or human law. A robber will never indulge himself contrary to this abstinence, nor lie with his own or another man's wife, for fear that God might in this case withdraw his blessing from his trade. What barbarism! what humiliating ideas of the Supreme Being! The ignorance and superstition of the *Bonzes* cannot possibly be above that of their Popes. Some of them are so ignorant as to be unable to read; what can they teach the poor people? They plow and till their ground, they attend their herds like other peasants, deal in every trade as *Jews*, and get drunk at the expence of their stupid parishioners, who sell them their sins, and



fancy to be happy and to be saved if they discharge their own and their deceased relations sins at a good price. The salutary ordonnances, which her majesty the queen has published against the illicit tricks of these Popes, have proved hitherto unefectual to rescue the people from that spirit of slavery wherewith they are subject to these spiritual masters. Her majesty's wisdom is equally eminent in protecting and propagating true religion, as in checking and extirpating superstition.\*

The religious rites and ceremonies of this people favour rather of Paganism and Judaism, than of that religion which they profess. For example; no woman will attempt to kill any animal whatever it be. The bride is on her wedding day, and the day before, constantly hid under a veil. Whoever unveils her is entitled to a kiss; and, if she desire it, obliged to make her a present. The women are in the churches separated from the men. Their funerals are singular. The corpse is with dismal shrieks brought to the tomb, in which

\* The above instance of her majesty's maternal care for her much-beloved, faithful, and loyal Hungarian subjects, who, in the beginning of her reign, unanimously declared, *Moriamur pro Rege nostro Maria Theresia!* is, indeed, a new laurel added to the glory of Austria, by so many victories over the Turks; and of late, by so many admirable laws and establishments for the improvement of commerce, trade, and husbandry, fixed for the latest posterity.

which it is sunk down as soon as the Pope has done with his ritual. At this moment the friends and relations of the deceased raise horrid cries. They remind the deceased of his friends, parents, cattle, house and household, and ask for what reason he left them. As no answer ensues, the grave is filled up, and a wooden cross, with a large stone placed at the head, to avoid the dead becoming a *vampyr*, or a strolling nocturnal bloodsucker. Wine is thrown upon the grave, and frankincense burnt around it, to drive away evil spirits and witches. This done they go home; bake bread of wheat flower, which to the expiation of the deceased they eat, plentifully drinking to be the better comforted themselves. The solemn shrieks, libations of wine and fumigations about the tomb continue during some days, nay even some weeks, repeated by the nearest relations. The funeral of a bridegroom is still more solemn. A pole, some fathoms long, is fixed to his tomb, and the bride hangs on it a garland, a quill, and a white handkerchief. They avoid going into our churches: If by accident they get there, they purify themselves afterwards by ablutions. To be sprinkled in our churches, or to undergo any ceremonies with consecrated water, is a matter of the greatest horror to them, because it is sprinkled about with an instrument made of pork-bristles



(*aspergillum*.) This makes them, according to their opinion, highly impure (*sportat*, as they call it.) Even their dresses suffering by such an accident cannot be worn again without washing. Their Popes distribute the consecrated water by a branch or nosegay of hyssop, according to the Psalm : (*Asperges me byssopo*.) For a long while I did not understand what the *Wallachians* meant by *Frate de cruce*, or *Mangar de cruce*. At last I have learnt it. If they engage themselves in an indissoluble friendship in life and death, they put the form of a cross in the vessel or the cup from which they eat or drink ; swearing everlasting fidelity. This ceremony is never to be slighted. It is generally a previous rite to robberies. The same ceremony is resorted to as the most efficacious bond ; for example, if robbers release a man, by whom they apprehend to be indicted, they oblige him to silence by an oath by the cross, the salt and the bread, which they call *Giurar pe cruce, pe pita, pe sare*. Their canon law is very different from ours. Stealing and adultery are considered as trifling crimes ; but violating or dishonouring a girl are great ones. No murder can be dispensed with by their popes. That dispensation is reserved to God alone. However, robberies and murders are extremely common among this people. The reason is obvious. They have no true ideas

ideas either of God or of the soul; how should not they be wrong in their ideas of the social and political obligations of man? Any phænomenon, or effect of unknown causes, is considered by them as a miracle. They look upon a solar eclipse as a fray of the infernal dragon with the sun; for that reason, during an eclipse, a great firing is heard through the land, to frighten away the dragon, which else might conquer and devour the sun, and plunge the world into eternal darkness. The insects which in the spring creep forth from under a rock near *Columbacz* on the limits of the *Turkish* dominions, and which greatly annoy their herds, are according to their opinion vomited by the devil. The holy knight, *St. George*, is said to have cut off his head in a cavern under that rock. A *Wallachian* will never cut a spit of beech to roast his meat on. The reason is, beech yields in the spring a red sap, and the sentimental compassionate tree weeps these bloody tears according to the learned and profound observations of the *Wallachians*, because the *Turkish* bloodhounds used to cut the spits for roasting Christians from beechwood. No capital punishment is in greater abhorrence amongst the *Wallachians* than that of the rope. The pale and wheel seem preferable to it. But why? A rope ties the neck and forces the soul out downwards. They call that a most disgusting



impure defilement of the soul, and I call their singular nicety on that account true psychological materialism.

Superstition being the daughter of folly, you may easily guess by the above instances how remarkably ignorant they are. Ask an old *Wallachian* what age he is? He will answer at the siege of *Belgrad* or *Temeswar*, at the conclusion of the peace, or when that prince died, or that metropolitan was elected, I attended the swine or the sheep, I went into the field, I married, and so on; and then you may cast up his age. They are not generally acquainted with the value of the current money. Even its denominations are not taken from their own language. A dollar, or thirty grosches, is called *leu*; a florin, *florint*; a half florin, *dult*; five grosches, a piece of their currency, is called *Strimbe*; half a dollar, *tri strimbi*. They have scarce any knowledge of the measure of liquids. The contents of a vessel is estimated according to the weight of the liquid contained in it. Their weight is the *occa*, a *Turkish* weight, answering to our two pounds and an half. One *occa* contains four *litre*, one *litra* an hundred *drams*.

The difference in the character of the *Raizes* and *Wallachians* is nearly as follows:

The *Raize* is fierce, proud, bold, cunning, a friend

friend of trade, fit to be a foldier. His Popes less ignorant than those of the *Wallachians*.

The *Wallachian* has no idea of haughtinefs, is a better husbandman, a friend of ease, and abhorring military life. They agree in being born robbers and slaves to their popes and national magistrates. The *Greek* alphabet is used by both these nations, but they give to several letters a different signification. However imperfect this sketch may be, it will do to give you some idea of a nation, which, as far I know, is still destitute of an historian, to acquaint the rest of *Europe* of its origin, customs and manners. To-morrow we set out, and by the next post I hope to send you a letter, which, containing objects, nearer to our taste, will prove more entertaining.



## L E T T E R IV.

*Oravitza, June 23, 1770.*

**I**T is not worth while to transcribe to you, my dearest friend, the *Wallachian* names of the insignificant villages, which I passed between *Temeswar* and *Oravitza*. The plain which from *Temeswar* stretches to *Theissa*, continued six stages more, or for twelve *German* miles to *Oravitza*.

Some hours before I reached this place, I saw to the left of the road some hills, which consisted of shivery, micaceous clay, and formed the promontory. Insensibly we ascended these hills, and reached at last the valley wherein the place is situated, from which I write to you these lines.

Here the argillaceous slate disappeared under the limestone, which hereabouts covers the surface. As soon as I arrived I called on Mr. *Delius*, whom, till now, I knew only by the reputation of his solid learning. But I was disappointed, the arrival of Baron *Hegengartben*, commissioned to examine and to improve the mines in the Bannat, did not leave him the requisite leisure to favour me with his remarks on the nature of these mountains, which as an exact observer he ought to be  
very

very well acquainted with. However, I have found another skilful miner, who yesterday evening gave me some particulars of the general division and other circumstances of the Bannat-mines. This has furnished me with the materials of this letter.

A line drawn from north to south through *Temeswar*, divides the whole country into two parts; that to the east is generally mountainous, and here you are only to search for mines. As often as I speak to you of their situation, it will constantly be in relation to the chief place, which is *Temeswar*. The mines now working in the Bannat are to the east, the ironworks *Bogshan*, properly *Passioven*; close to which is the new established iron-works *Reshiza*. Thence somewhat more to the south, are the copper mines *Dognaska*, farther off, *Oravitza*, *Saska*, and entirely to the south, *Bosniak*, or *New-Moldava*. In the plains bounded by the mountains of *Oravitza*, *Saska*, *Bosniak*, and those which run along the *Danube* and make the easterly limits, they wash Gold from the *Nera*, and *Menish-rivers*, nay every where from the ground which is adjacent to them. In former times private companies carried on these wash-works in the *Karansebes-Distrikt*, at *Konigseg*, and in other places; some are still going on.

All



All these mines are divided into four mountain-districts, which are called *Berg-Aemter*; such are that of *Bogshan*, to which *Resbiza* is to belong for the future; that of *Oravitza*, that of *Dognazka*, and that of *Saska*, to which is incorporated the market-town *Moldova*. They are under a direction, in which the president of the country generally presides. In former times it was at *Temeswar*; but for the future the president, a counsellor of the reports, and a secretary of this direction, are the only persons ordered to reside there. The other members, and whoever belongs to the chancery and the accounts are to reside at *Oravitza*. The mines near *Gross-Wardein*, and the bailiwick *Reszbania*, in *Upper Hungary*, are under the same direction.

LETTER

## L E T T E R V.

*Oravitza, June 26, 1770.*

**O**RAVITZA, as I have told you, already is the chief place of mines in the Bannat. The mines of its dependency were worked by the *Turks* as long as it was under their dominion; but with less profit than at present. After the restoration, the old mines were drained at the expence of the imperial treasury, and some new ones set at work; but all these mines, the royal galleries (stolln) excepted, were left afterwards by grant to several private companies, under several conditions and reservations, which being merely oeconomical, the translator supposes to be unenterprising, and useless to the *English* public.

LETTER



## L E T T E R VI.

*Oravitza, June 27, 1770.*

THE valley wherein *Oravitza* is situated, is bounded to the south by the *Wadarna*, *Csiklova* and *Temese* mountains; but to the north by those of *Cosbowiz*, *Dilfa*, and *Cornudilfa*. The mountains are here, as generally in the Bannat, gently ascending, and grown over with beech, birch, fir, ash and oak. Their rocks are argillaceous, mixed with sherp, mica, and feldspath; and this is covered either with argillaceous micaceous slate, or with a fine arenaceous or lime-stone. Between these last sorts of stones occur the copper-fissures (*Klufte*) which really deserve this denomination rather than that of veins, since they have neither a constant dipping nor a constant run. There has not yet been discovered at *Oravitza* any fissure, running or dipping above fifty fathom (*Klafter*.)

I have examined the *Cosbowiz* mountains, and found in them the following mines: *Rocchus*, *Erasmus*, *Jacobus*, *Benedictus*, *Gabriel*, *Paulus*, *Genovefa*, *Philippus*, *Maria*, *Maria Theresia*, or the *Goldsburf*, *Ladislai*, *Pyrite-mine*, and the *Kies-stock*, where a hundred weight (1. centner) yields seventy pounds

pounds of stone or lech. These mines are for the most part drained by a gallery (*erb-stolln*) which is driven in the field above 229 fathoms, and runs 19 fathoms below them. *Rocchus* is the richest; and on this account the chief gallery is driven to the south. Several drifts of smaller galleries serve to search and to work out the smaller fissures. The hanging side is limestone, the hading side slate. So it is likewise in the other mines, in these and the *Wadarna*, *Csiklova*, and *Temese* mountains, with the single difference, that according to the different situation of the mines, the limestone is either on the hanging or on the hading side, and that the sand-stone is often in the place of the slate on the opposite side of the fissures. The *Gang-rock* (that is to say the rock which fills the fissures) is for the greater part either calcareous or selenitic. The purer and the more sparry it is, the richer the ores contained in it.

I was very glad to be here convinced by my own experience of what Mr. *Delius*, in a *Vienna Magazine*, has published on the origin of the metallic fissures, and laid down as axiomatical rules for the mines in the Bannat; that is to say, that the metallic fissures are never to be found in the rocks, but between two different sorts of rocks. Full of this opinion I examined the *Cornudilfa* mountains, where in the *Trinity* mine I was assured of the hanging sides being lime-stone, and of the  
hading



hading fides being horn-stone. However, I took with me samples of these stones, as I used to do, and trying them with steel and aquafortis, I found that they are common grained lime-stone, and that the miners had denominated one species horn-stone, for its being finer grained and harder. This erroneous denomination of the miners may probably have led Mr. *Delius* to the above erroneous assertion. The same is observed in the other mines of the *Cornudilfa* mountains which are entirely calcareous; and in those of the *Dilfa* mountains, where generally the finer lime-stone goes under the false denomination of horn-stone. The gang or vein rock, in these *Cornudilfa* and *Dilfa* mines, is either granulated white or yellow gypsum, or sefinitic spar, which by a light warming gets a phosphorescence in the dark. The fissures of the *Cornudilfa*-mountains have a more even direction than in the others; but in *S. Servatius*, a mine working in these mountains, all the fissures are cut off by a brown argillaceous vein.

The *Wadarna*, *Cfiklova*, and *Temese* mountains and fissures agree in general with the *Coshowiz* mountains described before. One of the *Wadarna* mines, called *St. Paul's conversion*, yields some silver and arsenical-copper ore. I would not tire you with the list of the many mines which in all these mountains are working.

The

The common ores dug at *Oravitza* are a pale, yellow, copper pyrites; *pyrites cupri pallide flavus Cronstedts*, §. 198. Blackish grey, copper pyrites; *pyrites cupri griseus, ibid.* The last is often variegated in the surface. A species of pyrites, penetrated and incrustated with a brown copper mulm, is called broth ore (*Brüherz.*) It is found in *Trinity* mine, in the *Cornudilfa* mountain. This ochraceous ore is probably owing to a decomposition of the copper pyrites. The white arsenical copper ore, described by *Cronstedts*, §. 199, is common in the *Wadarna* mine, called *St. Paul's conversion*; but less white than that which breaks in *Herrn-grund*, in *Lower Hungary*.

In the same *Wadarna* mountains they found, twenty years ago, in *St. Anthony's* pit, beautiful *malachit ore*. *Ochra, veneris, calciformis, impura, indurata*, I could get no specimens of it; but they brought me from *Trinity* mine a fine *chrystalised azure copper*. The crystals are oblong, quadrangular, truncated. But to my still greater satisfaction, I got here many pieces of *red copper mulm* (*Ochra, Cyprii, Linn*) either dissolved in loose dust, or indurated and staining the fingers. *Cronstedts* has not described this species, unless it be that which §. 196, or 194, n. 4. he notices as found at *Sunnerkog*, or *Ostanberg*. It is likewise unnoticed by other mineralogists. Among several samples, a loose *cinnabar red ocher*, which girts a  
piece



piece of native copper, is highly remarkable. Its colour so high, as to mislead even the most intelligent connoisseur. If *Cronstedts* assertion be true, that copper, by the loss of its phlogiston, may be changed into copper-glass, one might guess by the richest of this ocher, which is 54 pounds per hundred weight, that it is a solution of copper-glass. But it is found in so large lumps, that this opinion is scarce admissible. The sameness of the colour has caused this ocher to be called *tile-ore*.

The following particulars of the pay and labour of the miners are left out, as uninteresting to an *English* reader.

LETTER

## L E T T E R. VII.

*Saska, June, 30. 1770.*

FOUR hours journey from *Oravitza* to the south is *Saska*, where I arrived yesterday before night, under a convoy of some *Huzzars* and *Wallachians*. The country between these two places is in this season extremely fine, and offers a continual variety of orchards, cultivated fields, meadows, plains and hills. The road runs all this way over glimmery argillaceous slate, which is now and then interrupted by some rocks of a grey argillaceous stone, mixed either with mica or sherb, with mica and feldspath, or with rocks of gneifs. *Saska* is situated in a valley surrounded with calcareous hills, superincumbent on slate, whose dissolved parts are carried by the rain water into the valley, and incrustate there the roots and mosses. The copper fissures, or veins hereabout, run between this grey limestone, and a margaceous rock mixed with basalt grains, the former being generally on the hanging and the latter on the hading side. I may be wrong perhaps, but I do imagine the origin of this hading side to have been as follows: The argillaceous grey stone, mixed with mica, basalt and little quarz and feldspath grains,

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which I shall call henceforth metallic rock (*Saxum metalliferum*) because the nobler veins in *Lower-Hungary* constantly cross it, and because the *Saxum metalliferum Linnæi* has so great an affinity with it; this rock I say may perhaps have been incoherent still, or less indurated when it was covered with limestone, and by that accident have been changed into its present margaceous nature. Any subsequent alteration or commotion, changing their former horizontal position into a dipping or oblique one, may easily have separated, and split fissures along their skirts, which are now filled with metallic masses between the calcareous hanging and the margaceous hanging side. These mines were taken up again after the restoration of the Bannat, about the year 1746. They worked first on some copper veins, lying open to the day. Then the *Wallachians*, who had been searching after mines, discovered some old pits and overgrown large bings, which proved that in former times miners had been working there. I have been shown myself in the higher mountains a great many pretty pure copper and lead slags, which evidence old parting-furnaces, though thereabout there does not appear any water sufficient to work the requisite bellows. Might not perhaps the ancients have trod their bellows, or worked them with engines? Might not they perhaps have smelted their ores in smaller furnaces with hand-bellows, in the same manner

manner as the *Finnlanders* and *Russian* peasants? At present the number of the several pits and drifts on small often inconsiderable copper or lead veins is astonishing. The chief are in *the Promontory* now *Nicolas, Theresia, Nepomucenus* and *Philip Jacob* mine. This last I have examined. It is one of the richest works at *Saska*. The gang-rock is as generally at *Saska* calcareous or felenitic spar, which very seldom alternates with quartz. In the *anterior middle mountains* is *S. Mary*, and other insignificant stock works, if small nests or lumps deserve that name. In the *upper middle mountains* are holes or quarries, whence they dig out from between the vegetable mould and the lower limestone a brown irony earth, which yields from two to six pounds of copper per hundred weight. The most considerable pit of that kind is in the higher mountains, called *Maria felsen*. It may have three or four fathom diameter on an equal depth.

Mr. *Delius*, in the above quoted Treatise, gives the following conjectures on the origin of this copper mulm :

“ Water is endowed with the quality of de-  
 “ stroying the form of metals, and restoring them  
 “ to another form ; I mean only to speak of the  
 “ mixture and external form of their masses, not  
 “ of their constituent metallic particles, which are  
 “ eternally permanent. This happens very com-  
 “ monly to the copper ores, and generally to those



“ which are pyritical ; they are subject more than  
 “ any others to be dissolved by water into vitriol.  
 “ Such a transformation of ores nature has produ-  
 “ ced in the mines of the Bannat near *Saska*, where  
 “ a whole mountain has been subject to it. The  
 “ copper is not mineralized, but it appears as a  
 “ metallic dust in a brownish earth, if properly  
 “ washed. This earth did not exist from the begin-  
 “ ning in that form ; but it was rather a copper-  
 “ pyrite, which by the waters has been dissolved.  
 “ The sulphurous acid went off washed away by  
 “ the water ; but ocher and the unmetallic earth,  
 “ which are the constituent parts of the copper py-  
 “ rites, remained, retaining the native copper par-  
 “ ticles as a filter. This formed the *Saska* copper  
 “ mulm.” Mr. *Delius* supports this opinion by  
 the copper-pyrites still found in the mulm, and  
 yet unaffected by the dissolution ; but however  
 probable it be, he has neglected a circumstance  
 which I confess myself to be scarce able to answer  
 for. The brown copper mulm under considera-  
 tion is immediately under the vegetable mould,  
 and its hanging side is limestone. Is there any  
 probability that these pyrites have been before  
 their dissolution without any roof or hanging  
 side ? If that be the case, the *Romans*, which,  
 according to Mr. *Delius*, have worked in these  
 parts under *Trajan* and his successors, might have  
 driven expensive shafts and galleries, whose cop-  
 per

per remains are still found in these mines? But they had a more easy way of getting copper. They wanted only to get the ore immediately, and by the least trouble. \*

Might we not rather conjecture that these fissures, when the ancients worked in these parts, had then their own hanging and hading side together, with a different position; and that after a previous earthquake it has been changed so as to deprive these fissures of their former roof and hanging side, and to expose the ores to destruction? An able miner, used to observe nature, might perhaps rectify these conjectures, which I scarce am bold enough to venture, as having had no leisure for proper examination.

*Bona Spes, Anna Rosina, Maria Snow, Mary's Visitation and Bonifacuis*, in the higher mountains, are equally remarkable mines, on account of their beautiful ores; and *Saska* is perhaps that place, which has supplied my collection with the richest crop of mineral curiosities. All the different species of copper ores, that of the *Mansfield* copper slate

\* The translator sees not the least consequence in this whole argumentation, as these pyrites might have been with other rubbish washed and accumulated on the limestone-ground, and the ignorance or neglect of the *Romans* cannot be fairly alledged against the hypothesis of Mr. *Delius*, since it proves too much or nothing.



excepted, and many more new and unknown ones, are dug hereabout in great plenty. In *S. Urban* I found native copper with a polished splendid surface, sticking to a matrix of clayish sandstone and quartz; and in the *New-Elias* I got native branchy and dendritical copper in white indurated clay. Native copper in loose brown copper mulm from the before described pits in the higher mountains, and in green and blueish copper ocher from *Mary's Snow*, are not unfrequent. I was presented with a sample of native woven copper, by its texture greatly resembling the woven silver, from *Johan George-Stads* in *Saxony*. This species is found in *Bena Spes*, in quartzous gang-rock, mixed with greenish lithomarga; grey copper glass, *Cuprum Sulphur mineralisatum solidum textura indeterminata Cronstedt*, §. 197, is found in *Philippi Jacobi* pit. It is malleable, and of a compact texture. They call it here *lech ore*. It breaks in scaly grey limestone; yields from sixty-three to seventy pounds of copper, and moulders by dissolution into a blackgrey dust. Red copper glass of an undetermined figure, *Minera cupri calciformis puru & indurata colore rubro Cronstedt*, §. 195, found in *Maria Brunn*, in a white gypsum tinged by verdegrease. In the same place it breaks in a fibrous verdegrease, which makes it very beautiful to the eye. Mr. *Delius* presented me with such a crystallized copper glass, which  
consists

consists of many accumulated red transparent triangular crystals. These, and a variety of octangular crystals, are found in *S. Urban* and *Mary's* visitation sticking to an undescribed copper ore. It is a brown red fine grained jasperlike stone, striking fire with steel. I might by Mr. *Cronstedt's* example, who calls our *Hungarian* zinopel *jaspis martialis* (Minerol. §. 65.) name it a copper jasper. It contains, separated from the richer crystals, from thirteen to nineteen pounds of copper. Some pieces mouldered into a red copper ocher, and containing in the middle only a remaining kernel of this red jasper, convinced me that the *tile-ores*, which are dug in the same mine, and which I have described at *Oravitza*, owe their origin and their riches to this jasperlike ore, and its copper glass crystals. Among a variety of verdegrease, *Ochra cupri viridis*, *viride montanum*, which is here very common, I received fine fibrous glossy copper green *Aerugo Linnae*. The fibres are for the most part concentric, pointed below but two or three inches, large and flat at the top. They call it *satın-ore* (Atlas-ore.) There is an innumerable variety of *malachites*, in thin flat plates, but knotty, in concentric coats, in thin undulated lamellæ and scales; its colours from the lightest to dark green in every sort of shade. The *Barmaster* in this place improved my collection by a sample from *Reczbania*, a copper



work in *Hungary*, under the direction of the Bannat. It is an indurated fibrous verdegrease (*Ærugo Linnæi*) which after the transmutation into malachite has preserved its original concentric fibres. Indurated copper azure (*Cæruleum montanum induratum. Cronstedt. §. 194.*) and crystallized azure, in glossy semi-transparent polyedrous crystals, offered to me in *Urban* and *Maria Skutz* mine. I gathered here for my mineralogical friend a good stock of the brown and grey copper mulm. Such an indurated mulm from *Philippi Jacobi*, and other mines, mixed with some phlogiston, smooth and glossy where broken, is on account of the likeness called *pitch-ore*. It seldom yields above seven or eight pounds of copper; but being commonly mixed with verdegrease, azure, crystallized red copper glass and native copper, it is generally ranked among the richest ores of *Saska*. Besides the *fallow copper ore*, *pyrites cupri griseus. Cronstedt. §. 198.* which they call here *white-ore*, any other sort of copper pyrites are found in these mines. In the upper middle mountains they find in some lead pits a light brown lead ocher, which is often mixed with white irregular spar-crystals. The above *pitch ores* are commonly covered with blue columnar hexagonal or polyedrous glossy crystals, truncated on both ends. They never contain any copper, and are but *blue spherl crystallisations*. Mr. *Dembsher*, a very intelligent

intelligent assayer at *Moldova*, has assured me, that for a long while he had, without any success, assayed these ores as copper ores, till at last he had found in *Lehman's* preface to *Marggraf's* works, that now and then handsome blue crystals had offered to him entirely destitute of copper, but containing plenty of iron. The only remarkable stones, which, besides the different rocks I have found here, are a white transparent calcareous spar crystallisation, consisting of columnar hexagonal crystals, with three large and three smaller opposite sides and a triangular point; a dodecaedrical crystallisation, composed by pentagonal faces, drawn in *Linneus's Amoenitatus*. tom. I. fig. 25; and a pyramidal, triangular, transparent selenit-crystallisation. As soon as I return I will divide my collection with you, knowing very well that they have raised your curiosity.

LETTER



## L E T T E R    VIII.

*New Moldova, July 1, 1770.*

THE daily examples of the ill use, which travellers in the Bannat, especially in these parts, are exposed to from the numerous gangs of robbers, had almost brought me to the resolution to give up my journey to this last boundary, which is separated from the *Turkish* dominions by the *Danube*. But I heard that these fine gentlemen vent their ill humour rather against their countrymen, which have the misfortune to fall in with them, than against any *German*, which is said to happen but very seldom. This circumstance, and my recollecting the chiefs of the robbers having sent word to the aulic commissioner, Baron de *Hegengarten*, that he and his men might in safety, and without any convoy, travel where he pleased, gave me resolution to attempt this excursion towards the east. Twelve mine-officers on horseback, and some common miners armed with guns, went with me. As soon as we had ascended the higher mountains of *Saska*, I observed that gneiss, now and then cap'd with common clay-schistus and limestone, covered the whole

whole country. This continued to *Moldova*. Some small copper veins basset out from the schistus. But the skilful miners do not work them, because they dip only some feet in the slate and then strike dead or disappear entirely. Perhaps after a long series of years they will dissolve into copper mulm as at *Sasku*, and then be got easily by posterity. After two hours ride we alighted at a copper furnace in the midst of a thick forest. The mine-officers from *Moldova*, and about thirty armed miners, had expected me there and joined our caravan, which now resembled a little army. I was agreeably surprized to meet here with my old college acquaintance, Mr. *Dembsher*, assayer and engineer at *Moldova*. This young man, possessed of all the theoretical and practical science of miners, of much learning and good taste, has for several years, by our continual correspondence, prepared me for a journey to the Bannat, and enabled me to make and to justify in a short time all the observations which I have given and shall continue to give you. His conversation, and the merry chearfulness of my convoy, diverted me so much, that I thought of no danger in the thick woods which we crossed to *New Moldova*. As soon as we arrived I visited the town *Moldova*, at the foot of the mountains on the *Danube*, to see some robbers who had been taken by a party of soldiers. They had brought along with them the head of a young man, who  
had



had bravely fought against them, and preferred death to chains. In the evening I returned to *New-Moldova*, or as they call it, *Bosniak*. The fine views from the hills were extremely pleasing. I saw from thence a large tract of country far in the *Turkish* dominions; but I did not see without concern the hills, which concealed from my eyes the former rich copper-works, near *Maidenbeck* in *Servia*.

To day I visited the mines hereabout. They are divided into three districts, that of *Benedicts*, *Florimund's* and *Andreas*. In the first are *S. Barbara*, *Trinity*, *Nepomucenus*, *God's hope*, and *fourteen Notbelfer*; in the second, *Joseph*, *Theresia*, *Archdutchess Mariana*, *Pelagia*, *Maria good Rath*; and in the third, *Andrews*, *Peter and Paul*, *Anton from Padua*, *Hilarius*, *Thomas* and *Helen*. They are all working, and yield fine copper ores from veins running in almost every direction. *Maria Theresia* yields lead. The hanging side of these veins is grey clay-schistus; the hanging side is limestone; both superincumbent on gneiss. These mines seem to have been worked in times of old; since the miners scarce have reached till now any found or new field, and get their ores only in the old man. The ancients have indeed left stupendous works in the *Besedine* mountains, which are not worked at present. They have formed works with chissels and hammers in rocks, which we hardly

hardly conquer by blasting. In some parts the walls are so flat and even, that they resemble rather stonecutters than miners work; where they met with loose crushed rocks, they left tremendous caverns. It is astonishing that the most ancient works are generally driven in the foundest rock. Whether they may be ascribed to the *Romans* cannot possibly be ascertained. The construction of these old galleries and drifts has nothing particular; it agrees with what you have seen in the *Trinity Erb Stolln* at *Shemniz*. The doors are either cut in solid rock or lined and fastened by uncemented masonry; their figure elliptical. They work here as at *Saska* on fissures, which are inconsiderable. The ores found in this place give the most malleable and tough copper in the *Bannat*. For this reason, and to encourage the working of the *Moldova* mountains, the imperial direction pays for the *Moldova* copper four florins extraordinary. Almost every sort of copper ore which I have mentioned, from *Oravitza* and *Saska*, are found here. *Native copper* breaks in *God's hope* in different forms. It sticks commonly to quartz. If found on black grey copper pyrites, it moulders in open air into a calx resembling pulverized tiles, but whitening still more and more. In this state of dissolution it scarce yields any copper at all. The native copper from *Johan Nepomucenus*, and *Barbara stolln*,  
are



are of the same nature. Red copper-calx is found in *Archduchess Mariana* in a matrix of asbestos, which contains likewise now and then some copper pyrites. In *Hilarius* I got some fine red copper glass crystals, and from the old bings of the *Besedine* mountains such crystals, and lead glance, which contain some silver.

My friend *Dembser* assisted me to get here a large stock of pitch, broth and clay ores, or of whatever other sort and denomination of richer ores. With this booty I return tomorrow to *Oravitza*, to pay my last respects to Baron *Hegengarten*, and to pursue by the road of *Dognazka* my way to *Transsylvania*.

LETTER

## L E T T E R. IX.

*Dognazka, July 5, 1770.*

THE day before yesterday I took my farewell of Baron *Hegengarten*, and arrived here after five hours ride. Clay-schist, mixed with mica, cap'd the lower granite, which now and then peeped from under ground, all the way long from *Oravitza* to this place. The mountains, which are working at *Dognazka*, are middle mountains, which rise from the plains near *Wersbez*, and run eastward to *Transsylvania*. The chief ridge of these mountains is granite, covered by gneiss, clay, sand and lime. The only constant vein (gang) in the Bannat is here at *Dognazka*. Its run and dipping is constant for a great while. It is situated in *John's mountains*, and consists of a lead and silver vein. They have chased it already in its run from west to east 1500 fathom, It dips from south to north. Before the last *Turkish* war they got here a good deal of silver. The following different pits, *Mary Christina*, *John* and *George*, *Susanna*, *Nepomuck*, *Barbara*, *Samuel*, *Mercy*, *Sweti Theodor*, and the *Herbestine* stoll are at present working upon it. This vein running along  
the



foot of the higher incumbent lime and slate-hills, the mines are greatly exposed from water. For the greatest part of the year they are under water; and though in *Maria Christina* they have of late built a horse-engine, in hopes to drain this mine, I am apprehensive it will fall short of expectation. This very circumstance hindered me to examine these mines myself, which I should have been the more inclined to do, as I cannot believe that the hanging and hading side of these veins in greater depth, but consisting of lime and slate, or of hornstone and argillaceous slate. However, that is the assertion of the mine-officers. I have examined the rubbish of these mines, and true it is, that it consisted of indurated shivery clay and limestone; but as this may be supposed to have been drawn only from the upper drifts, I am still of opinion, that in a greater depth gneiss or shirl-mixed argillaceous rock, *Saxum metalliferum* might be found. It is highly improbable that a constant quick vein should have such an uninterrupted run in rocks so accidental as these superincumbent clay, slate and limestone hills; and I have found in an old account of the *Bannat* mines, from the year 1748, that in the then new imperial stolln or gallery, after it was driven through the slate, they reached a very hard rock, which made the work go on very slowly; and that in the old *Josephi-gallery* they met with a  
rough

rough hard rock, which determined the proprietors to drop it entirely. Every enquiry was unsuccessful, since the mine-officers in these parts do not know any rocks but limestone and slate, and since accustomed to search after and to find their ores between these rocks, they neglect to observe any other sort. They have this fault in common with the mine-officers in the imperial states in general.

Ask them the nature of their mountains? and I am sure they will give you so indifferent a description, that you cannot make any thing of it, but that they never troubled their heads with such observations. However, the surest rules of a rational working of mines entirely depend on this neglected science of the mountains, their strata and their varieties.

I might alledge to you many examples of the ill consequences of this neglect. I examined a mine in *Hungary*, which in former times had yielded a rich overplus from a pyritical vein, containing gold, and crossing an argillaceous rock adjacent to granite. This vein was cut off by the granite, and as the same seems to have happened to a great depth the ancients gave it up. Of late they resolved to take it up again. They followed the line of the compass in which the vein was known to run, and drove a long drift through the granite to meet again with the lost vein; but

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without



without any success. The same would happen if they should search after it in the direction of its dipping; and all these pains and expences would have been saved if previously they had consulted and considered the nature of the rocks. After this occasional digression I return to *Dognazka*. Besides the before mentioned mines in *John's mountains*, there are several lead and copper fissures working in the *Wolf gang Dilfa* and *Morawiz mountains*; such as *Mary victory*, *Christoph*, *Traugot*, *Pancratius*, *New Gluckauf*, *Erasmus* in the former; *Rockus*, *Fabianus* and *Theresia* in the *Dilfa mountains*; and *Franciscus*, *Peter* and *Paul*, *Johanna*, *John Baptist*, *Trinity*, *Maria Litchtmass* *Paul* and *Simon Judas* in the *Morawiz mountains*.

*Simon Judas* is perhaps the most considerable copper mine ever discovered in Europe. After many insignificant searches on the surface, a company of adventurers united in the year 1740, and in hopes of some silver ores, pursuing the upper gallery in a dead fissure, drove many drifts in the field; but the adventurers gave it up, and a single remaining tenant, after being ruined, and having attempted a drift to the east, discovered a rich copper fissure, on which at last they sunk a shaft. The copper fissures crossing and uniting here from every side form a stockwork, as they call it here, though it be different from the stockworks after the *Saxonian* principles, which are entirely independant

of the rest of the mountain, and are said never to have any hanging or hading side. An unhappy avarice prevailed then on the associates, to encourage the finding of copper by prizes. The barmaster was allowed five, and the furnace master three grosches per hundred weight. This caused the barmasters to work as farmers, and to consider only their present advantage, without any regard what was to become of the mine in future times. Accordingly immense quantities were taken from this stock of rich ores, and tremendous caverns produced, which, unsupported, threatened inevitable ruin. But Count *Gotlieb Stampfer*, at *Shemniz*, was at last commissioned to examine and to prevent this bad practice; and Mr. *Delius*, then barmaster at *Dognazka*, ordained, that from the bottom of the stock upwards to the ninth level or gallery, the whole cavern should be filled up with deaf rocks, except some small doors and pits, left open for procuring the ore remaining in the depth. By this means the danger was prevented, or rather lessened. This remarkable work I examined yesterday. The rocks which surround it are *Saxum metalliferum* mixed with some lime. The gallery at the ninth level has been driven through it. The stock itself, at least that part which is above this ninth level, has a hanging side of a scaly white limestone, and a hading of slate; but the whole stock, or rather all these united veins, are incumbent on gneiss.



This gneiss-ground has been explored for copper fissures by shafts and drifts; but finding that there was no chance of success, the inferior part of the stock has been filled up, as I told you before, and this hindered me to see whether it does not consist of *Saxum metalliferum*, and whether this variety of rock has not produced the irregular dipping of the vein, which at present is ascribed to the large *Francisci* vein crossing in from the hanging side. At my entrance in the stockwork, I was greatly surprized by a magnificent view, which however, at second thought, I found equally tremendous. The whole and wide cavity of the mine was illumined with a vast number of tapers, and the workmen stood or appeared hanging on the projecting stripes, or soles of rich various coloured copper-ore. The form of this stockwork is oval; its uppermost or first level has a breadth of three or four fathom; but it increases so much, that on the ninth level it has twenty-six fathom length and twenty fathom width. From this level it decreases in the same proportion towards the under part. I have told you already that this copper stock, or copper belly, is meerly produced by the coincidence of several veins, on which account it cannot be compared to other stockworks, as that for example at *Geier* in *Saxony*; but it has likewise a visible run from east to west, and a dipping, which from the first level to the ninth goes from south

south to north, and thence to the sixteenth level, in an opposite direction, that is to say, from north to south. The depth of the whole stock is forty fathom, and the *Joseph-Shaft* is sunk into it. The rubbish and ores are drawn out by horses. So are the waters, which from the deepest sole are pumped up to the ninth level, where they are carried off by a gallery. The annual dividend of this work is at present greatly decreasing, so are the ores; and probably in ten or twelve years time the works will be at an end, since the many crossing veins, by their opposite directions, strike dead the rich fissures, concentrated in this spot of ground. The searching drifts on those cross veins give no hopes. Nevertheless they get still every month 7 tons and a half of copper. The ores are lying in so close a mass together, that scarce any dead rock is to be seen or dug out. For this reason the supports of the roof, and the stairs to the first, second, third and ninth level, which are still found, are cut in the finest variegated copper pyrites. The gang or vein rocks, which now and then offer, are a fine white and scaly limestone, calcareous spar, white achate with red and black spots, and yellow or black granulated garnet. (*Granatus figuræ incertae particulis granulatis. Cronstedt. §. 69.*) It is remarkable that, about an hundred fathom distant from the hading side of this stockwork, the *Paul's* lead mine, and in about a similar distance



from its hanging side, an iron mine is working. The ore of the latter is sent to *Bog sham*. As probably some fissures of these veins are crossing over to the adjacent stockwork, there occurs not only in the hanging side of *Simon Judas* leadglance in copper ore, and yellow crystallized garnets, which in *Paul's* lead mine are extremely frequent in and next to its lead ores, but in the hanging side the ores are striped and penetrated with ferruginous ocher. *Mary Victory's* mine in the *wolfgang* mountains has been but of late begun working. It is in metallic rock, *Saxum metalliferum*, which the miners hereabout call sandstone. The vein or gangrock is a fine dissolved white mica or glimmer, mixed with stone, and blended with copper pyrites. There is hope of good success. In *John Baptists* mine, in the *Moraviza* mountains, breaks white alabaster, girt with limestone and slate, and containing copper pyrites. The vitriolic acid of the pyrites might perhaps have changed the former alkaline gangrock into a gypsous substance. The *Isidore* mine has been dropt some years ago, for not answering the expectation. It seemed to me however very remarkable, as being for a long way covered with a brownish-yellow asbestos, containing iron glimmer and black iron garnets. This asbestos introduces itself into the copper fissure, and is the matrix of the copper pyrites. I made at *Dognazka* a large collection of

of scarce ores; and among the before described species I got the following samples:

Native lamellated gold in a brown iron clay from *Fabianus*. In this mine it is often found in lumps included in the copper vein.

Native copper from the same place, in large heavy lumps, which might be considered as smelted, if the red copper glass crystals, that surround them on every side, did not prove it to be produced by nature.

Native copper in brown iron ocher from *Simon* and *Judas* stockwork.

Grey crystallized copper glass ore. The crystals polyedrous sticking on quartz, from the same place

Grey variegated copper pyrites from *Simon Judas*, called copper glass, on account of its content of sixty to seventy pounds of copper, glossy on the fractures; differing from other copper pyrites by its red and blue colours not being superficial but penetrating its whole substance.

Red crystallized copper glass. The crystals oblong prisms, truncated on both ends. From *Paul's* mine. Scarce; found in brown copper ocher.

Red copper mulm (tile ore) girt with a coat of verdegrease, which seems to be produced by an acid solution of the copper mulm. From *Mary Lichtmass* at *Dognazka*.



Grey copper-pyrites) *Cronstedt*. §. 198.) crystal-  
lised. The crystals have ten faces. From *Simon*  
*Judas*.

Grey and yellow mixed scaly copper pyrites ;  
greatly resembling our scaly cobalt (sherben-co-  
bolt) however different on account of its yellow  
colour, from the same place.

Yellow and black undeterminate garnets, in  
large pieces, from *Paul's* mine. They call them  
yellow or black hornstone.

Yellow garnets of eighteen and thirty six points ;  
often of the bigness of a pigeon egg. The miners  
call them yellow blend. From the same place.

LETTER.

L E T T E R. X.

*Lugos, July 7th, 1770*

FOR this letter you are indebted to the neglect of the postmaster. I ordered the horses at four in the morning ; but he cannot procure me any before ten. For some hours I have been in this market town, visiting some of my acquaintances, who commonly in this season flock hither to a healthier climate, from the raging fevers at *Temeswar*. I owe you still a remark on the smelting in the *Bannat* ; and here you have it : The smelting and refining of the copper at *Oravitza* is nearly the same which you have seen in the *Lower Hungarian* works, and is done in four different smelting places, called the *Franciscus Mercy*, *Theresia*, and *Saiger-butte*. Great care is taken in rejecting the refractory ores.

Two tons of ore, twenty-four of pyrites and twelve carts of copper-flags are commonly put together in the first smelting. If the ores be remarkably sulphurous the quantity of pyrites is lessened ; so the quantity of flags if they be mild. In twenty four hours time the business is done. The whole  
gives



gives about three or four hundred weight of copper.

Seven tons and half of *raw-stone* (*Robstein*) produced by the first operation, make a roast.

The *black copper*, procured by roasting, is refined on a smaller hearth, and in smaller quantities of about four or five hundreds.

All expences cast up, a hundred weight costs the proprietors from nine to eleven florins.

The parting furnaces (*Sayger-butte*) are dropt at present, since the proprietors of the mines have found that their copper ores, containing silver, can be with less expence carried to and parted at *Thajola* in *Lower-Hungary*. The whole annual produce of *Oravitza* is about one hundred and fifty of copper.

*Saska* has four furnaces, called *Charles*, *Joseph*, *Maximilian*, and *Radimer-Hutte*. *Moldova* has but one. The process in both places is the same as at *Oravitza*; but the vicinity of large forests makes it less expensive; and the great plenty of copper mulm found at *Saska* makes it there very easy. The *Saska* and *Moldova* smelters boast of their smelting the ore with an increase of copper, its common assays giving only three or four pounds. This for a long while seemed a riddle to me; but I fancy with some reason,

son, that this additional produce is owing to their additional pyrites.

I have told you already that *Moldova* produces the toughest and most malleable copper. This seems owing rather to the sulphurous nature of the ore, than to any particular advantage in the smelting.

*Moldova* gives per year about 50 tons, and *Saska* about 150 or 200 tons of copper.

The *Dognazka* ores being greatly sulphurous, their smelting and refining is less expensive than at *Oravitza*, though the process be entirely the same. There are three smelting places, with ten furnaces. The ores, smelted promiscuously, and in common as at *Oravitza*, yield every year about 200 tons of copper. These ores, containing less than nine ounces of silver, cannot be parted in our inland furnaces; \* for this reason the proprietors have tried many experiments of other more successful proceedings. Even at present the surveyor, Mr. *Fluk*, has proposed a plan to precipitate the silver in the smelted

\* This does not give any credit to the skill of the *Hungarian* smelters. The copper and lead ores of the famous *Ramelberg* near *Goslar* in the *Lower Hartz*, do contain but about one ounce of silver; and are besides greatly refractory. However, they are with great advantage parted in the furnaces belonging to these mines.

copper,



copper, and by this means to save it. It would prove a great advantage to the proprietors. Mr. *Delius* has likewise proposed and advised some alterations in the smelting, to deprive the *Dognazka* copper of the brittleness, which the copper-smiths complain of.

Some days ago Baron *Hegengarten* received an account of the goldwashings in the *Almasz*, and orders of the court to examine them. Counsellor *Koczian* is author of this account, and I will send it to you as soon I shall hear of the result of their examination

The evening before I set out from *Oravitza* we had a terrible thunder storm. I happened to stand at the door, and to see under a violent lightning a flame rising behind an opposite house, which keeping itself some time at its top rushed at last down on its fore-side, and then returned to the place whence it first arose. This phænomenon was repeated several times. We examined the place whence this electrical evaporation came from, and found that pyriticous fissures lay hid under the vegetable mould.

My journey from *Dognazka* to *Bogsham*, and thence to *Lugos*, is one of the most singular I ever made in my life. The danger of the roads caused Baron *Hegengarten*, whose humanity you know, and whose kindness I never can praise too much,

to

to fend orders for my safety wherever I had to pass. Accordingly I found in every village forty or fifty *Wallachians*, armed with firelocks, who under the conduct of their chiefs escorted me to the next, and in rough or stony roads did bear my coach rather than support it with their shoulders. The same day there was a general chace in the country to surround the forests and to search after the robbers. This is done once every year, but commonly without any success, since the requisite orders cannot be kept a secret from the robbers, who for that reason stay quietly at home that day, or even dare, in compliance to the orders, to follow the general chace. *Bogsham*, where I dined, is but four hours journey from *Dognazka*. This place is situated in a fine valley, surrounded with clay slate and limestone hills, superincumbent on our metallic rock (*Saxum metalliferum*.) The river *Bersova* runs through it, but the adjacent fens and swamps make its situation very unwholesome. As *Servia* continued under the imperial jurisdiction, this place had many fine buildings and iron hammers; but now the iron trade is stopt. Nevertheless there are still some iron hammers, and furnaces; and vast quantities of bullets and shells are cast here for the imperial artillery. The iron ore comes from *Dognazka*. It is either red ore, *ochra ferri indurata rubra*; or black, *ferrum refractorium tritura atra textura chalybea*; and



and gives a good iron. Near *Bogsham* is a calcareous hill at a place called *Valga baja*, which contains immense quantities of broken oyster shells and mytulites. From *Bogsham* to *Lugos* is a continual ridge of granite hills, below shivery micaceous clay. From *Lugos* they run to the east towards the high mountains, which separate *Transylvania* from the *Turkish* dominions. The calcareous hills about *Lugos* produce good wine; and I taste it at present to your health

APPEN-

# A P P E N D I X I.

F R O M

MR. CHRISTOPH. TRAVGOTTS DELIUS,

Affessor in the Direction of the Mines in the Bannat :

A Proposal to soften the Copper, presented to  
the Imperial and Royal Chamber Court  
at Vienna, *July* 16, 1768.

**T**HE copper ores, whether mineralized with sulphur or arsenic, or with both together, contain, besides the copper and the unmetallic earth, a part of iron ; and they are distinguished only by its greater or smaller proportion. The yellow pyriticous ores for example, the rainbow coloured, the fallow, the copper and the glass ores, and in general those that are remarkably mineralized with sulphur, contain more iron than the green and blue ores ; but the copper ochres and liver ores contain more of it than any other species. This iron mixture, if in the smelting and refining it be not entirely removed, is the proper and real cause of the brittleness of copper ; and though it be likewise produced by arsenic, this however happens



pens only if this half metal be united with iron, since by itself, and unconnected with iron, it is too volatile to resist the intense and repeated heat of the copper preparation, if the roastings and smeltings be properly directed. Therefore the great principle to get a fine, malleable and soft copper consists in its careful separation from the iron; and the usual practices are chiefly aimed at it, though by the following reasons they fall more or less short of their intention.

It is a known fact, that nothing destroys iron so fast and efficaciously as sulphur. Though commonly the copper ores contain a good deal of sulphur in their mixture, it is insufficient by itself to destroy the admixed iron. Therefore a certain quantity of sulphur pyrites is added to every first smelting of copper ore, to get its sulphur mixed with the iron, to have it by this sulphur in the ensuing roasting of the lech or raw stone calcined as in a cementation; and lastly, to have the remaining sulphur and iron scorified either in the smelting of the black copper, or in its final refining. This method of smelting, invented by our ancestors, is in the main so well adapted to nature, that with all our refinements we are at loss to invent a similar or a better. It would certainly and perfectly answer all its ends, if there was not a circumstance which causes difficulties, and is proved by metallurgic chemistry; and that is, that all sulphur-pyrites contain a good deal of iron.

iron. Accordingly what is procured by one side is in a certain respect lost again on another. Its sulphur may very well be supposed to destroy the iron particles of the copper ores ; but as it contains a good deal of iron in its own mixture, its sulphur is insufficient entirely to destroy the iron in the compound mass, a part of which unites unaffected by it with the *lech* or *rawstone*. In the ensuing roasting the sulphur, which remained in the rawstone, together with a part of the iron, is destroyed by cementation ; the former evaporating, and the latter changing into dross, which in the following black copper smelting is taken off with the slags. On this account a part of iron remains in the black copper, which in the last refining cannot be entirely destroyed, as then scarce any sulphur is remaining. Hence it comes to pass, that provided there be no want of good intelligent smelters, those places produce the best copper, where the ores contain but a small quantity of arsenic and iron, and where they have plenty of good sulphurous pyrites. If any pyrites was to be found entirely destitute of iron, it would undoubtedly produce the most excellent and ductile copper. But as that is not to be expected, and nature has not favoured our wishes, we are to look about us for other means to soften the copper ; for which reason, and the encouragements granted by her Imperial and Royal Apostolic Majesty,



I venture to propose some of my ideas, established on many assays and experiments. However, before I come to my manner of refining the copper, I shall lay down some rules, which are highly subservient to the purpose, and should never be neglected by those who are at the head of any great metallurgical works.

*Primo.* As I have shown already that pyrites, containing much sulphur and a smaller quantity of iron, proves an advantage in the first or raw smelting, care is to be taken that such pyrites, and not indiscriminately any other, be chosen for the raw-work. No pyrites is to be made use of which is both arsenical and sulphurous, since arsenic unites with the iron, and causes a great brittleness. For that reason the furnace inspectors ought to examine their pyrites and their constituent parts, which commonly is neglected; since for the most part being unskilled in the operations of metallurgic chemistry, they are unable to make such analyses. However they assay them with proper fluors for lech and stone. But the produced lech or stone-grain being a compound of sulphur and iron, it is impossible to know by this useless assay how much sulphur and how much iron is contained in the pyrites, and whether any arsenic is united to them. Sublimations in closed vessels are preferable in every respect; and smelters and assayers ought to chuse this method, since in the  
assays

assays of every sort of ores and minerals it certainly is more instructive and precise than the common empirical assaying. If by these means good pyrites be procured, proper care ought to be taken of the proportion, in which it is to be added to the first smelting. This is to be determined by the quality of the ore; if irony and refractory the addition of pyrites ought to be in a larger quantity.

But many faults are committed on this account; since many furnace inspectors, by a misapplied œconomy and to save some pyrites, or to have the rawstone rich, and to save the trouble and expence of roasting, grudge the addition of pyrites, and by that spoil the nature of the copper. There is never any real advantage in the riches of rawstone, since it impoverishes the mass of sulphur, which in the ensuing roasting is insufficient to destroy the greater proportion of iron. A good lech or rawstone should, to produce ductile or good copper, never contain above seventeen or eighteen pounds of copper in an hundred weight.

*Secundo.* If a copper mine produce pyritical and sulphurous copper ore, which, without any addition of other un sulphurous ores, are smelted with sulphur-pyrites as usual at *Smolniz*, it is greatly productive of ductile copper to have both ores and pyrites gently roasted before the first smelting. The reason is as follows: Sulphur



does not destroy the iron, by its combustible matter; since consisting of vitriolic acid and phlogiston, the latter evaporates by a gentle roasting. But the vitriolic acid penetrates into the iron, dissolves it into a crocus and destroys it, which causes it in the ensuing smelting to go easily off with the slags, and to leave the copper regulus or the rawstone in a more depurated state. Though this be an undoubted principle of rational metallurgy, I fear it will be objected to by some smelters, who know only ancient practices. Would they please fairly to try some experiments they might be convinced of its utility. However, it is to be observed *first*, that this rule is not general, because, if refractory or unfulphurous ores are to be smelted together with the more fulphurous ones, the roasting is impracticable, since the vitriolic acid and the sulphur of the latter, requisite to the fusion of the former, might be inconsiderately destroyed by it. *Secondly*, I have said for very good reasons, that the roasting ought to be gentle. A violent roasting might smelt the ores and unite the sulphur to the iron and to the copper; and it is a known fact, that sulphur, destroying iron in a gentle cementation, by a strong fire, is brought into fusion with it. Besides an intenser roasting would destroy too much sulphur, which, after the raw smelting, is likewise intended to scorify the deaf substances of the ores.

*Thirdly,*

*Thirdly.* On these principles there might be laid down many improvements of the common roasting of lech or rawstone. Any roasting intended to be useful ought to be gentle. The object of roasting rawstone is partly the evaporating of the combustile sulphur and of the volatile arsenic, so as to bring the mass of ore closer together, and to facilitate its subsequent fusion into black copper; and partly the producing of the sulphurous acid and its calcining and destroying the iron of the rawstone. This double object is better obtained by gentle than by violent fire. In a strong fire the ores coagulate and smelt together; the arsenic uniting with iron is fixed, and both make with the fluid sulphur and copper a compound mass, which is hard to part again. To be convinced of it, melt iron, sulphur and arsenic into a regulus, pulverize it and expose the powder to a gentle fire; you will find these minerals evaporated in a short time, and the destroyed iron remaining in the crucible. But put the same in a smelting fire, you will find the whole for many hours in fusion, without any remarkable decay or destruction.

To obtain the ends of gentle roasting the following rules are to be observed:

1. The roast ought never to be in open air, but to be included by walls and to be sheltered, to shut out the irregular blowing of the wind and rain and



now, as either producing by intense fire a partial coagulating and smelting of the mass, or by interrupted fire an unequal and imperfect roasting, which in either of these cases puts a stop to the intended evaporation of noxious minerals, and the destruction of the iron.

2. The masses ought not to be too large. The common practice at present is to roast one hundred and eighty or about two hundred hundred weight of lech or rawstone together; nay, some furnace inspectors, to save a trifle of charcoals and wood, go still above that quantity; but this grudging œconomy spoils the copper, since the greater the heap the greater the fire, which is produced by the greater quantity of sulphur, and causes a smelting and coagulating in the mass, whose obnoxious effects have been touched upon before. More and smaller masses, each of one hundred, or at most one hundred and twenty hundred weight, might be preferable; so it will prove equally conducive to spread the ore in thin layers over the alternate wood, and only to employ in the first fire as much fuel as might be requisite to a gentle roasting, which in the following fires is constantly to be kept gentle and equal.

3. In some cases the double rawsmelting is to be considered as a great advantage to produce ductile copper. Innoxious to any ore, it might be superfluous with some sorts; but it is highly  
useful

useful and necessary for those that are arsenical and irony, or refractory on account of brittle and deaf minerals or half metals. It is impossible by the first smelting to remove the greater part of these noxious minerals, and it is equally difficult in the subsequent roasting and black smelting to deliver the metal from their influence. Therefore two or three gentle roastings of the lech or stone of the first rawsmelting, and its subsequent second smelting with a proportionable quantity of pyrites into a *double lech*, are to be greatly commended, since the sulphur of the pyrites unites in the second smelting with the destroyed minerals, calcined by the preceding roastings, and carries them off in slags. This *double lech* is then to be brought to a regular roasting, and afterwards smelted into black copper. But in this process the rule of an equal gentle roasting is more carefully to be observed than in any other; else the whole will run together, and the wild and deaf minerals so closely unite to the copper, that it will prove almost impossible to separate them again.

As it is an acknowledged rule, that only *good black copper* produces a *good fine copper*, I do not dwell any longer in recommending the preceding general rules, and the careful roasting, which is too much neglected. By what I have said it clearly appears, that the fine copper will be brit-



tle and irony, in the same proportion as the previous works have been neglected. However, whatever care be taken there will still remain some iron, even in the refined copper. The reason is this: A hundred weight of good black copper contains commonly about ninety pounds of fine copper, and about ten pounds of iron, or sometimes arsenic united with iron. The trifling quantity of sulphur still existing in it destroys during the refining a part of this iron, and even the fire scorifies a part of it; but as generally the iron in the black copper is equal in weight if not superior to its sulphur; this little sulphur is certainly unfit to scorify it entirely.

Therefore I have supposed, that during the refining something might with great advantage be added to the copper, to purify and to soften it entirely.

Two mineral substances destroy and scorify iron, litharge and sulphur.

The former is unfit for the refining on the *hearth* (*Gar-berd*) since the glowing coals which cover the copper might reduce it into lead, and this uniting with the copper cause it to be leadish; but in a *parting furnace*, where the copper is kept in fusion by the flame, it might do, since wood flames do not reduce it, facilitating rather the calcination of lead, and leaving it floating as litharge on the surface of the copper. Being under  
these

these circumstances in a continual motion on the surface of the boiling fluid copper, it will attract the remaining iron particles, scorify with them, and leave the copper in its highest purity. The quantity of litharge is to be determined by the lesser or greater quantity of black copper. Six or eight pounds per hundred weight might do.

Concerning the refining *on the hearth*, the best effect is to be expected from common officinal sulphur. The iron has no greater enemy, and it does not affect any other metal as long as it has iron to work upon and to adhere to. Accordingly, as soon as the black copper is brought to smelting fusion and boiling sulphur in pieces ought to be put on its surface, and covered with coals to concentrate the boiling. This may be repeated two or three times; but the compound sulphur and iron slags are carefully to be taken away, and no more sulphur to be added, than what is requisite to destroy the iron; else the superfluous sulphur uniting with the copper causes unnecessary expences and lengthens the refining. For this reason the black copper is previously to be examined. In proportion to the iron contained in the black copper, three, four or five pounds of sulphur will be sufficient to its destruction, and to the copper's highest refining and softening.

This sulphur-refining will equally do in the parting furnace.

These



These proposals are, for what I know, entirely new and never practised before; however, they are so adequate to the natural rules of metallurgy and so cheap, that I dare hope they will not only stand the trial of impartial intelligent smelters, but prove likewise highly conducive to the production of fine, soft and malleable copper.

### P O S T S C R I P T.

It has been demonstrated before, that the copper will be less irony in the same proportion as the pyrites added in the first rawsmelting are destitute of iron. But as the pyrites are commonly to be used as they may be had, and generally any sort of them contains a good deal of iron, the following process is recommended as an improvement of the first rawsmelting.

At present the pyrites is added to the rawsmelting of the ores in its natural form; but it would be better to smelt it separately, and to bring it previously into a sulphurous regulus, since the greater part of its iron will be by such a smelting brought off in dross, and its lech or regulus consist for the greater part of a pure sulphurous mass. This sulphurous regulus I propose to mix with the copper ore in the first rawsmelting; and half the quantity of the usual natural pyrites will be

be sufficient to produce a less irony copper regulus, which according to my rules, and properly roasted, will undoubtedly give a very malleable copper.

The objection, that this separate and preparatory smelting of the pyrites will cause a considerable expence is of no great weight with me; since the pyrite regulus being a milder and easier flux than the unprepared raw pyrites, the fire and time requisite to prepare the pyrite regulus will for a great part be saved again in the easier and shorter rawsmelting.

A P P E N-



## A P P E N D I X II.

Observations on the Goldwashings in the Bannat,

BY COUNSELLOR KOCZIAN,

With the result of the enquiries made after them

BY MR. DEMBSHER.

**A**MONG the several natural advantages of the *Temeswar Bannat* some of its rivers are known to yield gold-dust. I could not neglect this object when lately I travelled in these parts.

The goldwashing in the Bannat is properly the business of the gipsies (*Zigeuner*) and left as it were to this poor people as an exclusive trade. This laid me under the necessity to apply to them for instruction.

The river *Nera* in *Almasb* carries gold-dust, and seemed to me the fittest for my purpose; accordingly I caused some gipsies, reputed to be very skilful, to make a washing near a village called *Boshowiz*; and I saw with pleasure, that with much dexterity in a few minutes time, they cleared in the trough the value of some groshes  
of

of gold; they showed me likewise among their gold-dust some pieces of a remarkable bigness.

After having sufficiently observed and examined their simple manipulations, which I shall speak of more in the sequel, I wanted to know the origin of this river gold.

A particular circumstance favoured my curiosity. I saw that the gipsies washed it from the sands not only taken in the river, but likewise from its borders, nay even from some pits in the adjacent ground. These pits are commonly four foot and more deep, and yield richer sands than the river itself. They told me likewise, that the river sand grows richer in the same proportion as the waters are high; and that it is poorer in dry weather. Such it was in 1769, and consequently they were forced to open the goldsand pits in the adjacent grounds.

I examined these pits and the country around the *Nera*, which has been delineated in the annexed plan.

The strata on its borders are as follows: The first is common vegetable mould, nearly of one foot thickness; the second loam, two feet; the third pebbles and calcareous earth, hard to be dug with pickaxes, one foot and a half; the fourth or the goldsand bed is three feet, consisting of a mixture of pebbles, rockstones and fine iron sand. This last stratum is the same which the gipsies



gipsies, at thirty fathoms distance from the river, dig out for washing. According to what I could see in the pits this bed has a slate bottom; and somewhat lower down the river a large coal-stratum bassets out. I might therefore say with some probability, that after the slate follows clay, then marle, and afterwards the coal bed.

From all this follows, 1. that the gold-dust is not generated by the water, but brought in the river beds by accident, because in the former case it ought to be found in constant and equal quantities, whether the water be high or low. 2. It ought to be had from such beds which may be easily dissolved by water; accordingly it is not owing to found veins, since rain water and torrents cannot possibly be supposed, in their short and intermittent flowing, to carry off even that part of gold which they commonly leave behind; and besides they would have long since discovered the veins in the many countries where gold is washing, and where no such veins have been found out. 3. Therefore the gold-dust is probably owing only to clay and earth beds, dissolved and carried off by water.

The bed which the gipsies dig out is of such a dissoluble nature; it is gently dipping, and by what I could see ascending or rising from the west to the east. Being in this hanging or gently dipping situation, it may possibly be laid bare in several

veral parts of the river borders, and washed off by high water, which very well explains the greater success of the washings after heavy rains.

On my further journey in the Bannat I observed many marks of old washings, probably left by the *Romans*. They pursued likewise the gold impregnated beds, which in many places must be six fathoms above the river borders. Near *Wersherova*, *Polvaszniza*, *Purlava*, *Tumul* in the *Karansebez*, and in the valley *Walle-mare*, towards the limits of *Transsylvania*, from *Obava-Pistra* till *Marga*, it is plain that they dug for gold in such elevations, which never could be reached by the river water. In *Transsylvania*, near *Olak Pian*, at the foot of the *Rudel* mountain, many old gold-pits are found in a dry country, which is entirely destitute of brooks and rivulets.

This clearly shows that the gold impregnated beds are not to be considered as river sediments deposited on the borders. § If they were successively accumulated and washed off from the adjacent hills, there is no reason why the gold should be

§ This may be and certainly ought to be granted, in respect to the present visible brooks and rivulets; but may be with equal justice denied in respect to those of former times, since the surface of the earth has undergone so many successive revolutions, and ancient seas, lakes and rivers are every where traced in the present continent by their former effects.  
(Transl.)

only



only contained in a single bed, and never to be found in the upper vegetable mould?

The solid compact stratum of dragged pebbles and rocks, which is superincumbent on the gold bed, is a further argument for its not having been produced successively; since no reason appears why the gold-dust might have been carried and deposited under this compact stratum. ||

Therefore we have the greatest reason to believe, that the gold impregnated bed is owing to the deluge, and that accordingly it is wide, stretching through considerable tracts of land.\* In this supposition remains but a single question: whether this bed be throughout impregnated with gold? Though this might be affirmed for very good reasons, I will however, to corroborate it, take notice that the *Romans*, beginning their washings near the river, continued them a hundred fathoms length in the adjacent lands, and as long as they could reach and easily lay open the gold

|| These two inductions are extremely precarious. Might not successive revolutions, whatever they were, produce different strata of a different nature? (Transl.)

\* The latter is fact; and the diluvian supposition a bad consequence drawn from precarious inductions as well as from too narrow principles. (Transl.)

bed

bed without driving galleries, which seem to have been unknown to them. †

By similar circumstances the gipsies have no chance to make any greater progress, being confined to the gold which is carried by the rivers, or contained in the less incumbered and buried gold-bed near their borders.

However, the object being of importance, and deserving nearer examination, I should advise to drive a gallery in the gold impregnated bed, and to examine how far it runs into the field, and whether it constantly keeps the gold impregnated quality? If it should be found to extend a considerable way in the mountains, and to continue gold impregnated, it would be worth while to have large washings on regular hearths.

The present manipulation of the gipsies is as follows: They use a board of lime tree one fathom length, and one inch and a half thick. At the upper end is a small trough, and across the board are ten or twelve small cuts or furrows. This board they raise at one end, under an angle of nearly forty-five degrees. The sand is put in the trough at the upper end, and

† Mr. Koczian is very unhappy in suppositions. Had he never heard of the *cuniculi* of the ancients? What are they but galleries?



thence by plenty of water washed down the sloping of the board. This causes the lighter sands to be washed off, and the heavier ones to remain in the furrows and on the surface of the board, whence they are scraped or brushed off, to be separated from the gold by the operation of the common trough. Their whole proceeding is so extremely careless, that a good deal of gold is lost by it; and what is still more to be pitied they get but the pure gold-dust, that which is still sticking to the sands and stones being thrown away, as I am convinced by the microscope, nay even by simple ocular inspection.

This circumstance deserves nearer examination: whether these sands and stones be rich enough to bear the expence of pounding? A small trial might be sufficient. If they should appear to bear it, regular mining and pounding would be adviseable.

I cannot conclude without adding a particular observation, which I had an opportunity to make near the many old and new gold-washing places in the Bannat, and which I consider worth attention. I found that the higher promontories on the gold impregnated rivers do not consist of solid rocks, but of soft earth-beds, which give good indications of coals and alum ores. Near *Boshowiz* on the *Nera*, which is known by its gold-washings

washings, I saw a large coal bed bassetting out at a small distance from the gold sand bed; and almost in every place, which I have spoken of before, the exterior appearance of the ground countenances the conclusion, that coal beds are below the gold impregnated stratum, and that these in a certain respect are to be considered as its sole. They had perhaps some share even in the generation of the gold; at least, they have a great relation with gold, since it is not impossible to extract from them a *hepar sulphuris*, which is the strongest dissolvent of gold.

However this be, it is fact that coals are to be found in every gold washing-ground. The *Danube* and *Enns* may stand an evidence, since on the borders of the *Danube* from *Vienna* to *Passau*, nay still higher up, coal beds offer every where. Therefore I do not doubt, that the same gold impregnated stratum may be traced out on the borders of these rivers, and regularly worked to advantage.

According to these observations and accounts of Counsellor *Koczian*, and the orders which I had received, I proceeded to my enquiries in the following manner:

As soon as I arrived at *Boshowitz* I enquired after the place, in which Baron *Koczian* had made his observations; and I found it as laid down in



plate to which this explanation is belonging.

A. *Menish*; a brook.

B. *Boshowiz*; a village.

C. The ground, where Baron *Koczian* caused his washings. It rises gently towards the mountains; and

D. a gallery of one fathom length was drove into it.

E. The coals in different beds.

F. Mouth of the *Menish*, where it runs into the *Nera*.

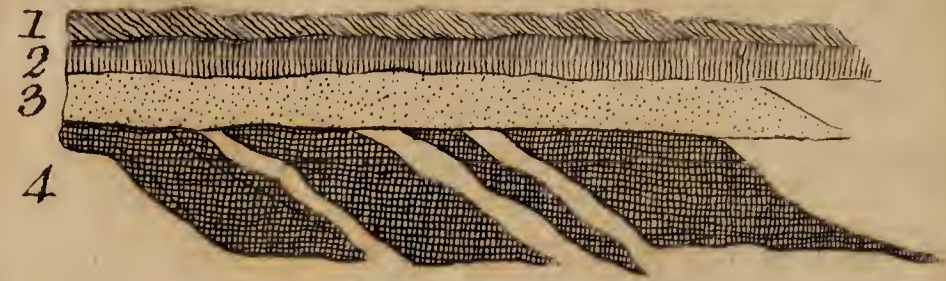
Near K and L the ground is very flat; and consists, as appears in some higher borders, of different stratified earth and stone beds.

After a general survey I caused the works at D to be cleared, to get acquainted with Baron *Koczian*'s gold impregnated stratum and its foundation. I found it agreeing with his description, and consisting of a mixture of brown loam, pebbles, rocks, mica, garnets and iron sand. But the under bed was no slate, consisting rather of a brown sandstone, extremely mouldering and friable in the pit, and hardening in the open air.

Acquainted with the object of my enquiries, I advanced 27 fathom nearer to the mountains, and ordered a shaft to be sunk in G. In a depth of one fathom and a half I reached the gold impregnated stratum. A washing convinced me of its containing



1. Turf and Vegetable Mould.  
2. Pebbles and detached Stones.  
3. Auriferous Sand.  
4. Coals.







containing gold; and I ordered thirty carts load to be laid aside for a great washing on the hearth. I advanced then still twenty eight fathom more, almost to the foot of the mountains; and to be convinced of the extensiveness of this stratum, I caused a shaft to be sunk in it, twenty-two fathom to the south. Here I found the beds entirely different. The grey loam immediately under the turf was very tough, and a fathom thick. Then followed brown loam five foot, afterwards the compact pebble bed four  $\frac{1}{2}$  foot, and then the gold impregnated stratum. After a little trial in the trough, I ordered as much to be laid aside as might be full sufficient for a washing at large. Then I proceeded to these washings on a hearth, exactly constructed as those at *Skemnitz*. The result was as follows:

*First proof.* Thirty carts from the shaft G yielded two grains of gold.

*Second proof.* Thirty carts from the shaft H yielded scarce half a grain of gold.

The greatest care was taken, and I was too well convinced, that such profits could not bear the expences of mining, which, as here to be undertaken immediately under the turf, would require a good deal of timber, of which the whole adjacent country is entirely destitute.

Therefore I dropt my works in this place, and examined the bed which is gently rising on the



coal stratum along the *Menish*, and in several places is three fathom above the water level. I constantly found some gold flakes in the trough; but in so small quantities, that I saw no encouragement for a washing hearth, and I gave up every hope of mining. The common gold-washers having for the most part retired to *Banya*, *Ruderia* and *Telposhiz*; I followed them to these places to examine the ground and earth which they were washing there. At *Telposhiz* I found it as in the before described places; but at *Banya* and *Ruderia* I saw the gipsies seeking for gold in the gutters and furrows of the mountain-brooks.

So much for the history of my enquiries. I shall add some observations produced by them, and explanatory to those of *Counsellor Koczian*.

1. As soon as a shaft or drift reaches the gold impregnated bed you reach water. This is so general that I have found it so in the shaft H and E, three fathoms above the water level of the *Menish*.

2. The gold washed hereabout is entirely native, free from any matrix. It appears in fine dust. Tho' the exterior appearance of this mixed stratum convinced me, that it is not owing to gold veins and fissures, and that accordingly its rocks and stones cannot possibly contain any gold, I caused however for my fuller conviction the washed sands  
and

and stones to be stamp and washed again. No gold appeared. I then had them roasted by fire, but without any better success.

3. The deeper this bed under ground the richer. It grows poorer in the same proportion in which it ascends to the mountains; which in a certain manner is to be explained by the first observation.

4. This gold impregnated bed yields every where a pure black splendent sand, which might be called perhaps native iron, since it is drawn by the loadstone.\* In the gutters and furrows at *Banya* and *Ruderia* but an insignificant quantity of this iron sand is found; they give a greater quantity of pyriticous sand, which, together with the ores and gang-rocks, is a strong presumption for copper mines. The fine situation of these mountains, water, wood and timber being plenty, might give a zealous miner a mind to explore them.

It is very difficult to determine the origin of gold-dust contained in this stratum. Though the discovered beds, the extensive coal stratum, and now and then some petrifications, be strong evi-

\* The translator has verified this observation in the gold-washings on the *Eder* in *Hesse*. He might perhaps give a natural reason for this iron sand, which constantly is found concomitant with the gold-dust.



dences of great inundations ; there appears no sufficient reason why the gold dust should be only mixed in the substance of a single bed ? As I am no friend of conjectures, I leave the explication of this phænomenon to men of greater genius, enabled by their extensive knowledge and experience in Natural Philosophy, to make discoveries beyond my capacity.

I am to answer here to an objection which seems to be a just one, and is, that notwithstanding the poorness of these sands, the value of some thousand florins of gold is produced every year. Though this be fact, and a considerable sum in itself, it is a very inconsiderable one in respect of the great number of people employed in the washings. There were for example in the year 1770, in the neighbourhood of *Uy Palanka*, *Orsowa* and *Caransebez*, above 80 families of goldwashers, men, women and children, employed in that business ; and nevertheless they have not made good above the value of six or seven hundred ducats. Hence it appears to me that these washings are no objects for miners, and less so for *Germans*. The gipsies go half naked ; whole families live at the daily expence of a groat, nay cheaper. Satisfied with this petty allowance, and unconcerned at their nudity, they wash gold in summer time, and during the winter they cut wooden troughs,  
spoons

spoons and the like, which they ramble about with felling and begging. A miner would scorn such a life; and if you would keep them better, whence is to arise the profit of the sovereign, which in the common way of the gipsies is something, though it be inconsiderable?

Concerning their manipulation it seems to be at first sight very rude and bungling; but it is very just in itself. Practice has given them an experience, destitute of which one might consider their process as very deficient. I am convinced of it by its following examination. When they had finished a washing of fifteen or twenty troughs of sand on their usual board, which is seven foot in length, rifled with fifty or sixty transverse furrows, and erected under an angle of eighteen or twenty degrees, I caused the sands, which remained in the furrows, to be divided into three parts. The greater part of gold stuck constantly in the ten or fifteen uppermost furrows; in the ensuing division I scarce met with the eighth part of the former; and in the last fifteen or twenty furrows scarce two or three flakes of gold were to be found. I have likewise carefully examined the sands, which they had washed already, and it was but very seldom that any mark of gold was left in them.

Such



Such was the result of my first journey, which, contrary to my expectation, produced a second. Unluckily I had not clearly enough explained my third observation; and Baron *Hegengarten* was hence inclined to believe, that the gold impregnated bed might prove richer in a greater depth. Therefore he proposed to sink in K a shaft of nine or ten fathoms depth, till a solid found and barren rock might be reached; and I was accordingly ordered to return with two able workmen in the *Almasb*, and to try the experiment.

It was *June* 13th in 1771 when I did so. The point K is about three feet above the water level of the *Menish*, which having in E torn off a steep part of its borders, and by that accident laid open the coals and the other strata, I could with certainty foretel that the sole of the gold impregnated sands would prove to be either the coal or the alternating marle beds. With the same probability I might have foretold the bigness of these strata.

After  $\frac{3}{4}$  fathom of vegetable mould I reached the first sand and pebble bed and water, which increased, arising from the sole, in the same proportion as we sunk deeper. Two troughs of rubbish were had with five or six troughs of water. This circumstance and the constant rains filled my unsheltered works with so much water, that by twelve hours labour I could not get but three foot depth. After one  $\frac{1}{2}$  fathom I reached the  
gold

gold impregnated bed, which I very often examined on the trough, but constantly found so poor that a large mine trough contained often but a single flake, and often nothing at all. At last we fell in with the coals, and having sunk my work  $\frac{1}{2}$  fathom in them to no purpose, and found that the beds were the same as those by accident laid open in E. I gave up my works in this place, and examined rather these discovered strata. The result was the same as that of my former enquiries.

My many small washings did not encourage me to further experiments; and thus I dropt my repeated enquiries.

To prevent all further doubts I add an observation, which proves with nearly mathematical evidence that this side the *Menish* only coals and marle, and on the other side towards the mountains only slate and sand stone will be found by digging deeper.

The gold impregnated stratum is constantly parallel to the turf and vegetable mould. It does not answer at all to the dipping of the lower stone beds. This appears clearly in E, where marle and coals, alternating with regularity, are never parted by earth beds but covered by the gold impregnated stratum, which is parallel to the turf. The section plate explains it to the eyes.

Here



Here the question arises again: why this gold was produced in this stratum? I freely confess that I am at a loss to answer it; but I cannot entirely abstain from proposing some conjectures, which perhaps may assist others to discover the secret.

The hypothesis of those, who explain the origin of coals by forests, buried and swallowed up by earthquakes, gains some credit by the exterior appearance of the *Almasb*, whose soil is every where intersected by hills and rivers, and is entirely destitute of wood. But the remarkable regularity in the alternating and parallel coal and marle beds does not agree with the idea of such dismal and violent destructions. The structure of the uppermost loose soil in these parts is more easily to be explained by inundations. It is a known fact that gold and iron are generated and produced in many flat countries, and that these metals are dug in many places besides the common veins and fissures. The Dutch sea sand and the iron, which in different places is found concomitant with the gold dust, are strong evidences. § Supposing this native gold to have been contained in the uppermost and looser beds of the

§ Of what? That the gold or iron is generated in these beds? No; that they are commonly found together, and that having perhaps had a common origin, they have been washed and deposited there by the same revolution or natural cause, whatever this be.) (Transl.

hills,

hills, it could be thence carried by inundations into lower grounds, and as inundations do not retreat but successively, gold, iron, garnets and shirl ought of course, and according to their specific gravity, to have taken the lowest place, and to be deposited in those flats, which as the lowest have been intersected by the rivers.

This opinion agrees exactly with experience, and explains the reason why the gipsies get greater quantities of gold in high water than in dry weather. By heavy rains the borders of the rivers and brooks are worn away; nay, under such circumstances, the rivulets take often a quite different course. This facilitates the manipulation of the gipsies, because the water dissolving and carrying away the argillaceous particles, and leaving only the heavier sands and the gold-dust behind, they get by a single trough of sand as much gold as they might have washed from two or three troughs of the undissolved natural sands.

But is this an explication of the origin of this gold dust? Certainly no. However, I have done what most naturalists do, I have advanced my opinion.

FRANCIS DEMBSHER.

LETTER



## L E T T E R. XI.

Nagyag, July 12, 1770.

THE plains, which I reached near *Lugos*, continued half ways to *Dobra*, where I found an ascending ground of argillaceous slate. Beyond *Dobra* I met again with our *Saxum metalliferum*. It continued to *Deva*. The roads are impassable. Between tremendous precipices and the river *Maros* on one side, and steep shaggy rocks on the other, I was dragged along, by eight oxen, added to the four horses of my carriage. I arrived late in the night at *Deva*; but the safety of the roads made amends for their roughness. As soon as I came to the limits of *Transsylvania*, between *Dobra* and *Deva*, the two huzzars, which I had taken at *Lugos*, left me. *The Transsylvania Wallachians*, more humanized than those in the Bannat, and the national frontier troops, together with the severity of government against the robbers, contribute greatly to the safety of the country. It is but of late that three robbers have been at *Deva* impaled alive, for having committed some murders in the valley of *Hazeg*. This cruel  
and

and almost inhuman punishment, tho' used in *Slavonia* and the *Bannat*, has made such an impression on the inhabitants, that you may travel all the night with safety. The day after my arrival I visited the copper-mines, which some years ago have been opened in a mountain to the west, three quarters of an hour's journey from *Deva*. The mountain consists, at the foot, of a micaceous slate, covered with indurated marle rocks gently rising. In these rocks are the fissures, which compose the copper stockwork at *Deva*. I desire you would understand the word stockwork in the same sense in which I explained it to you in my letter from *Dognazka*. However, there is a great difference between the stockworks of these two places. That at *Dognazka* consists of large and very rich veins, converging and uniting in the same point: here it consists of some fissures, uniting in a middle of ten fathom diameter, and mixed with dead rocks. They have pursued the run of the fissures, and sunk in it a shaft of some fathoms depth, but without any success either in the drift or depth. The vein (*gang-art*) is grey and loose clay, now and then sprinkled with quartz and spath, and containing various coloured and yellow copper pyrites, which, if of the richest sort, contain seventeen pounds of copper per hundred weight. A hundred weight of this copper contains one dram and two denarii of silver; and



and a mark of this silver two and a half denarii of gold. They cannot yet part either the silver or the gold, but they hope to do it by a future better smelting process. The works in the mine are crippled. Wherever they found some ore they eagerly took it out, but left the work as soon as they broke off. Hence arose so many holes, that the work resembled rather those of rabbits than of miners. They have not yet any smelting furnaces of their own; accordingly they send their ores to the silver furnaces at *Csertes*.

In the afternoon I continued my way to *Nagyag*; and passed the other side of the *Maros* over high mountains, consisting of argillaceous rocks, mixed with mica and shirl, and covered with argillaceous slate. After three hours ride I reached the village *Nagyag*. It has given its name to the town, which is one hour and a half's journey higher up in the hills, since it was the nearest place when these gold-mines were discovered. I got here oxen to my carriage, because the little *Hungarian* horses, fit for plain countries, would not have answered these steep and high mountains. Towards night I arrived at *Sekeremb*, the proper name of the place commonly known under that of *Nagyag*. All around you see but forests, and in a valley some hundred houses, stamp-mills (*Pochwerke*) bing-places, some large washing houses

houses, the council-house, and a church. The situation of this place, and the coldness of the weather, are unfit for husbandry. The trade of the inhabitants is mining, and what belongs to it. The timbering of the mines, and the consumption of the inhabitants, have cleared the forests so much that the timber for the mines is to be fetched from abroad floated on the *Maros*, which passes at the foot of the mountains. The noblemen, as lords of the ground, have no objection against this clearing of their forests; nay, they keep great herds of goats, to prevent their growing up again. Every nobleman keeps on his ground an inn, to sell wine to the miners; and as the proprietors of the mines have engaged to discharge every month what their workmen may owe for wine, they have allowed for it the liberty to cut down in the forests whatever may be wanting for their mines and buildings.

The mountains are here entirely composed of our metallic rocks (*Saxum metalliferum*) which are covered with red argillaceous clay. The gold mine owes its discovery to accident.

A *Wallackian*, whose name was *Armenian John*, came to my father, then possessed of a rich silver mine at *Csertes*, telling him, that as he constantly observed a flame issuing from and playing upon a fissure in the *Nagyag* forest, he was of opinion,

H

that



that rich ores must be hid under ground. My father was fortunately adventurous enough to listen to this poor man's tale; and accordingly he drove a gallery in the ground, which the *Wallackian* had pointed out. The work went on some years without any success, and my father resolved to give it up. However, he made a last drift towards the fissure, and there he hit the rich black and lamellated gold ores, which first were looked upon as iron glimmer, but appeared what really they are as soon as assayed by fire. This happy accident caused my father to pursue the work to the utmost of his power; accordingly he distributed some shares among his friends, and had the works carried on with regularity. Soon after they discovered, besides the *Ergezebarw* and the *white fissure*, three other fissures in the hading side, and a soaring fissure, which, mostly parallel among themselves, run in the direction of the valley from south to north, dipping from west to east. These veins break off as soon as they reach the red slate which covers the valleys. The cause is obvious to you, and gives me good hopes, that whenever we shall chace these veins under the plane, on which the slate is superincumbent, their run will be uninterrupted, since then no cause remains to intercept it.

In the opposite mountain we have discovered another fissure, called *John Nepomuck*. It has a  
constant

constant run to the same point north, in which probably all these veins will cross and meet together.

The *John Nepomuck* vein has proved dead hitherto; however some small nests of ore have been hit already, and those permit us to hope that it will prove richer in the ascent of the mountain.

All these veins fall, and have been worked already to sixty fathoms. It has been observed that those, which towards the day or the turf were poor of silver and rich of gold, proved in the depth richer in silver and poorer in gold. The reverse happens with those that in the uppermost galleries yielded more silver and less gold.

Hitherto we have the advantage to run our ores by the galleries immediately to the bing places and stamp mills; and many years ago we begun (*erb stollen*) a draining gallery, which goes thirty fathoms depth under the present deepest sole; nay, the nature of the ground allows us to think of a still deeper gallery.

Our draining gallery is driven twelve fathoms in a bed of coarse blunt pebbles mixed with some clay. Had it been more indurated it would have proved a fine Breccia. Then followed the red shivery clay, through which we have



forced our way 370 fathoms length. At present we work in sandstone, which grows harder as we go on, and gives good hopes that we shall reach the micaceous clay rock, and in it after a twenty fathoms drift the veins which cross it.

The mouldering and foul quality of these different strata has made our galleries expensive and difficult.

To have at all events proper air conductors, and the requisite room for the water channel, it was to be twelve foot high; and the sides and roof were to be fastened by oak door stocks, each a foot thick, and set close together.

At the entrance of the gallery is a fan ventilator briskly turning by a water-wheel in a close room, whence wooden air-pipes and conductors convey the air at the bottom of the drift, and cause its requisite circulation. The conductors (*wetter-lotten*) consist of four boards nailed together, and made tight in the joints by a cement of clay, tile-dust, and tallow.

The workings are extremely regular. You would rejoice to see in many places four, nay even five platforms one above another continually yielding the richest ores; and it would certainly please you to find in many long drifts a roof of three or four foot large veins, which ensures to the proprietors rich dividends in future. The  
miners

miners are not allowed to work in the richer veins, but near them in the hanging side. Being nicely laid open that way, the sole is wiped clean, cloths are spread upon it, and then the vein is taken down in the presence of an officer. This they do at the end of any working day, or at the end of the week; and prevents not only spilling the ore among dead rocks but stealing it too.

By the *Daniel-shaft* the air is conducted into the deepest drifts, and the conveying of the ores in the galleries promoted.

The vein rocks consist of red feld-spath and white saponaceous quartz, (*fetter quartz.*)

The richer ores are lamellous, splendent and black-grey; the lamellæ to be separated from each other by a needle as those of mica. They may be cut and bent.

Another rich species is finely woven into the substance of a bleak reddish feld-spath, resembling the arsenical white ore from *Saxony*; but the fire proves it to be native silver, of a yellowish colour, on account of its mixture with gold.

Among the rich lamellous ores now and then occurs native silver mixed with gold.

Another rich species is called by the miners *cotton ore*. It consists of little native silvery gold grains, in a black gold mulm, sticking in an argillaceous matrix.



The other ores are likewise lamellated, but these lamellæ are but thinly sprinkled into their substance. Some are entirely similar to the scaly antimony and stain the fingers; others have a mixture of black lead lamellæ, which in closed vessels are unaffected by fire, but under the muffle yield a small corn of gold. In the midst of this ore is very often found a radiated crystallized, but commonly a scaly and plumose grey antimony. *Antimonium plumosum*. Red solid and crystallized arsenic, calx or orpiment, *calx arsenici*, *sulphure mixta*, *rubra*. *Cronstedt*. §. 241. n. 2. and fine grained cinnabar, are not uncommon. All these semi-metals brought to the couppelle leave signs, nay now and then small grains of gold.

The richer ores are in wooden troughs carried to the separating rooms, and there as nicely as possible separated by officers under oath.

The richest species contains from ninety to 340 ounces of silver in a hundred weight; and each mark silver yields 200, to 210 denari gold, that is to say, twelve or thirteen ounces gold, or two parts gold and one part silver. The rock separated from this ore, yields from fifteen to twenty ounces silver, and this from 160 to 170 denari gold per mark. The splittings and offal of this ore gives from twenty-five to thirty ounces silver, and this from 180 to 190 denarii gold.

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The poorer ores are separated in the wash-works by iron sieves. The greater pieces, which do not pass the first sieve, and those that pass the first and second, are with hammers separated from the dead rocks. Those that pass through the third and fourth are taken care of by the sieve-masters, and the dust running through the remaining sieves is washed on the common hearths. These pyritous ores give two or three ounces silver, and this in the mark from seventy to 112 denarii gold. The separated dead rocks of this ore are stamped, and with the common ores pulverized and washed. They yield one or one  $\frac{1}{2}$  ounce of silver, and this per mark from 100 to 130 denari gold.

Whatever care you may take with stamping and washing the richest *Nagyag* ores, the best microscope will not discover any flake of native gold. Counsellor *Scopoli* has chemically analysed them in his *Anno iv. Historico-Naturali*. Professor *Schreber* has given a translation of his treatise in his collection of Finance Tracts. You have read them, and you will have perhaps an opportunity to examine the constituent parts of this unique gold-ore and Mr. *Scopolis*' Essays.

The ores are assayed every month, and accordingly separated. The richer ones are pounded in iron mortars, sprinkled with water, put into



sacks, and together with the sprinkled ores and washings carried by horses over the mountains to the royal market at *Zalathna*, there to be assayed again by a royal assay-master, and to be paid accordingly to the proprietors.

The ores being watered they count at *Zalathna* three pound per hundred weight less. 2. They are charged smelting expences two florins a hundred weight. 3. And five per hundred fire loss for the gold as well as for the silver. After these previous deductions the mark gold is payed to the proprietors 300 florins; and the mark silver nineteen florins thirty cruizers.

Victuals being extremely dear at *Nagyag*, as being carried there by men or horses, the wages of the workmen are higher here than in many other places. These and the common mining expences amount from six to 10,000 florins a month. Nevertheless a dividend of eight, ten, nay of 20,000 florins is distributed every month among the proprietors; so that in twenty years time above four millions of florins gold and silver have been produced in this single place.

The proprietors have transferred upon her majesty the Empress-queen the principality or the right of regulating the mining works. Her majesty was possessed of sixteen shares or actions. However, the proprietors are in cases of importance

tance still ask'd their opinion. At present the works are under the direction of Mr. *Daniel Castellano*, her majesties barmafter. He is a miner of great experience, well acquainted with the nature of these mountains and successful in his undertakings. He is the first in *Transsylvania* who built regular stamp-mills, and demonstrated the advantage of the *Hungarian* stamp and washing-mills to those that objected, by clearing in a single day 300 weight stampt ores with seven stamp and wash-mills built at *Nagyag*. The scarcity of water has very often in dry weather put a stop to them; therefore the proprietors are building at present a great water reservoir in a higher ground, in order to supply the mills during dry weather.

LETTER



## L E T T E R. XII.

*Zalathna, July 15, 1770.*

*T*RANSSYLVANIA deserves to be examined by a naturalist endowed with a proper knowledge of minery. All the mountains of this beautiful country are full of signs of undiscovered metals. Had I not had a time prescribed, within which I was to return to *Shemniz*, I should not have left so soon a country which is so interesting to me, not only for being my native country but for being so rich in natural curiosities. It would certainly have made me rich amends for the pains of my enquiries.

The best and only reputable book on the Natural History of *Transsylvania* is, *Samuel Koleseri from Keres-eer Auraria Romano Dacica. Printed at Hermanstadt 1717.* The author, a learned physician, and afterwards inspector-general of the *Transsylvanian* mines, has in this valuable book rather described the antiquity and flourishing state of the *Dacian* mines during the reign of *Trajan*, than their productions and natural circumstances. With greater presumption but less learning a certain jesuit, *P. Fridwalzky*, attempted of late  
the

the Mineral History of *Transsylvania*. His book has nothing to tempt you but the title, *Mineralogia Transsylvaniae*. The materials of this dull performance are a variety of good and false accounts compiled from able but generally ignorant miners, which the good-natured priest was unable to make use of; false denominations of minerals arising from want of knowledge; half a dozen pious tales, fit for the entertainment of old gossips; some authorities taken from *Koleser*; absurd inductions, consequences and conjectures, arising from a thorough ignorance of chemical and mineralogical principles; and a good deal of civility and compliments to those gentlemen, who entertained *P. Fridwalzky* with hospitality in his excursions of mineralogical knight-errantry. Even the language, in which all these fine rareties are described, is such bad Latin, and so overdone with flourishes, that one is in want of the sense of *Ædipus* to guess that of *P. Fridwalzky*. I shall have perhaps an opportunity to converse with this highly celebrated *Transylvanian* mineralogist at *Clausenburg*; then I will tell you who he is, and whether perhaps in future times we may expect some amends for the singular raree show of his former performance. The mineral history of my noble country forces me often to a desire to make here a stay of some years, in order to satisfy my curiosity, and to hunt it over in the remotest



remotest corners. At present I can only usefully employ the short stay which is allowed me; therefore I went the 13th from *Nagyag* to *Zalathna* here to examine the neighbouring mines. Our metallic rock (*Saxum metalliferum*) composes the mountains, over which the roughness of the roads allows no ride but on horseback. These argillaceous rocks are two hours journey beyond *Nagyag*, either entirely bare or covered with a reddish indurated shivery clay. Near *Barzcha*, a *Wallachian* village, rises a still higher calcareous mountain, superincumbent on the before-mentioned ground. It shews every where indications of copper ore, and some adventurers have worked for it without success. Near the village *Glut* the mountains slope into the plains and the limestone disappears, instead of which the red shivery clay is seen again. Being dissolved in its surface into a red mould, all the country about *Zalathna* seems to be red coloured. After a five hours ride I reached this place, which is at present, what it was in *Trajan's* time, the seat of the upper court of mines. The many old inscriptions offering hereabout, and mentioning the *Procuratores Aurariarum Daciae* and the *Collegia Aurariorum*, established in these parts, make *Zalathna* extremely interesting for antiquarians. *Zamosci*, *Lazius*, *Kolefer* and *Fridwalzky* have compiled

compiled and published these inscriptions. This place is situated in a pleasant valley, intersected by the river *Ampoi*.

The *Wallachians* consider this town as the metropolis of their nation in *Transsylvania*, and repair to it in the market days. The greater part of the buildings are inhabited by mining officers.

The administration of the mines established here differs from that in the Bannat in this circumstance, that every society of actionists may as they please work their mines independant of the royal officers, under the condition however to deliver their gold and silver in the royal office at a fixed tarif of 300 florins a mark gold, and of 19 florins 30 cruziers the mark silver, with a deduction of five per 100 for fire loss. Societies, that have not got any dividends, have now and then allowed them a higher price.

The upper direction is subordinate to the *Transylvanian* chamber of finances at *Hermanstadt*; but this in respect to the mines to the court chamber of the mines at *Vienna*.

The justice of the mines is independant of this direction, and decides the variances of the different societies and the miners. Besides there is a royal gold office, where at certain days the wash-gold of the *Wallachians* and gipsies is bought at a settled



bled price at two florins thirty cruizers per pifeth; three pifeth three denarii being equivalent to one ounce of gold. If the gold be already purified by mercury, it is bought fifteen cruizers dearer.

This office is a great advantage for the poor *Wallachians*, since they are enabled by it to sell every week without imposition whatever be their small provision. As commonly the gold-grains sold to this office are scarce three or four denarii weight, it is impossible to assay each separately, and to pay them according to their proof and real value. Hence arises the necessity of an equal price, without any respect to their different interior value, and consequently an opportunity for the *Wallachians* to adulterate and heighten the weight of their gold by a mixture of silver filing, as soon as they are convinced of its superior purity. You scarce would imagine that these small and trifling grains of the *Wallachians* amount every year in the whole country from seven hundred to a thousand weight of fine gold.

Not to lose any time I hastened after dinner to the rich *Maria Loretto* gold-mine on the *Facebay* mountains, near *Zalathna* to the north. After half an hour's journey I reached the foot of the mountains, covered with argillaceous slate, superincumbent on grey horn-slate. The mountains rise gently; however, at first sight of their  
high

high elevation they seem to be steep and inaccessible. At an elevation of 150 fathoms the ancients have driven the *Sigismund* gallery. According to a traditional saying it was begun in the fifteenth century, under king *Sigismund*, and yielded then amazing treasures; but considering its having been cut through a solid hard hornstone, above 300 fathoms in length and six feet high, its sides being fair and even as stone-cutters work; and the length of time requisite to work out such a long way without blasting, one is rather inclined to look upon it as a work of *Roman* slaves condemned to the mines. Perhaps the works were only taken up again under king *Sigismund*. It is remarkable that this gallery is driven in a straight line and direction to the fissure; and hence it appears to demonstration,\* that the *Romans* knew to apply geometry to subterraneous

\* If it was proved to demonstration that the *Sigismund* gallery really is a *Roman* work: however, we need not be anxious about their subterraneous geometry. The *Grotta di Paulipppo*, the subterraneous aqueducts from *Lago Albano* near *Castel Gandolfo*, the stupendous *Cloaca maxima* at *Rome*, and many other of their buildings, are unquestionable evidences of their skill under-ground; and they might, as well as our common miners in *Derbyshire*, with a simple board, or rude *tabula prætoriana*, take up the subterraneous angles, and by that means, without any magnetical needle, hit under-ground whatever point they pleased. (Transl.)

works



works of this nature. In the roof of this gallery are some indications of former air-conductors, and these seem to have been considered in its height. The vein runs from south to north, and is crossed by the above gallery, which runs in west.

*Quartz* and *Hornstone* (*Petrofiliæ Cronstedt*, §. 62.) are the vein-rocks, in which offer the auriferous pyrites. These contain from two upwards to ten, twenty, forty, nay sometimes more ounces of gold. Besides an auriferous pyrites of four ounces value, they find a common grey clay, which yields some gold by washing.

This mine is not at present under the most fortunate circumstances. Superincumbent on it is grey clay and argillaceous slate, which probably seem to be the rocks of the *Maria* mine, situated somewhat higher to the west. I could not see it; since I was to examine the famous *Loretto* mine and then the return.

About fifty fathoms above *Sigismund* mine I met with the sandstone, which is the rock of *Loretto*, and accordingly is superincumbent on argillaceous slate. The gallery was driving in a finer yellowish sandstone. *Cos particulis distinctis*. Then followed a species of stone, which is called *backstone* and consists of blunted rocks ferruginated by common clay. *Breccia arenacea*, *Cronst.* §. 275. Afterwards came grey hornstone, *Petrofiliæ*,

*Petrofilex*, in which two veins, fourteen fathoms distant from and parallel to each other, are running. One is called the silver the other the gold vein. Both have smaller concomitant ramifications. The silver vein contains auriferous fallow ore, yielding up to eight ounces of silver per hundred, and its silver twenty and more denarii of gold in the mark; however, according to a common ill opinion against the silver mines in *Transsylvania*, it is not working. They are the more assiduous in the gold vein.

In the midst of the grey hornstone is a round cone or wedge of sandstone, as forced in from the turf. It is from two to three feet diameter. They have sunk in it a shaft eight fathoms deep. This sandstone consists of a variety of successive coarse and fine grained, grey and yellow horizontal compact sandstone beds, of a different thickness; some being not above one inch, some above a foot in thickness. Every bed has a particular gold mixture, which arises from the auriferous pyrites sprinkled more or less in these sandstone strata. One of the inferior beds for example yields four ounces, the superincumbent one 100 ounces, another two ounces, another fifty, and another still superior to those 200 ounces gold per hundred weight. As far as I may judge by the samples which I have taken with me, it seemed



to me that the finer grained sandstones are the richest. However, the inspector and chief proprietor, Mr. *Weisse*, assured me, that this observation is not general.

Another circumstance in this problematic mountain puzzled me still more. I observed in the grey hornstone a great number of round holes, three or four inches deep. At first I considered them as the remains of blasting-holes; but enquiring after the reason of these so numerous miscarried blastings, I was assured that these holes are natural to the rock, and that each of them naturally contains a blunted pebble. Really I found in the greater part of them blunted pieces of flint, or of indurated clay, which seem to have been hardened and blunted by rolling before they were inclosed in this hornstone. I here frankly confess my ignorance. It is impossible for me to explain the origin of this paradoxical mountain, or with the utmost stretchings of my fancy to create a tolerable hypothesis. See whether you can assist me, or whether your observations in other parts of *Europe* enable you to explain this phænomenon.

This mine I fear will not be long working; because, whatever be its riches, it seems to be in a diminishing state, as the veins in the hornstone begin to break off; and after the draining of the  
little

little stockwork of auriferous sandstone no great hopes seem to be left, nor any probable chance to make new valuable discoveries within the small compass of a ground which is at the top of the mountain. This is the more to be apprehended, as, by an unaccountable neglect, they have not thought in so rich a mine of a deep gallery or drift, which being driven a-cross the whole mountain, would most certainly have laid open, whether or no there are other veins and riches under-ground. They have but of late begun to drive a gallery under the pit, which will enable them to sink it ten fathoms deeper.

The ores of the *Face bay* mountain are remarkable phænomena for mineralogists. Common pyrites of no promising appearance contain from two to 600, nay to 900 ounces gold. On some pyrites the gold appears in a metallic form; on others it is sprinkled as *Spanish snuff* (*Brunnich's new edition of Cronstedt's Mineralogy*) on many others no gold is to be discovered by the strongest microscopes. This species may be stamp'd to the finest powder, and no washing will produce the least suspicion of any gold-dust.

The workmen know their inner value at first sight, and they are so very skilful in separating the ores according to their value, that the assay-master of the proprietors makes no other sorting,



but takes of each sort a general proof; whereupon they are delivered to the royal furnaces to be assayed again by a royal officer, and to be paid their thus stated value.

Any bit of these pyrites brought under the muffle, or to any other fire, the gold appears presently sweating out on the surface in little globular grains. The same happens with the gold-ores from *Nagyag*. This circumstance has caused some mineralogists to suppose, that the constituent parts of the gold, hid in the substance of the ore, unite by the fire, and that the wanting parts, probably the requisite phlogiston, being added by the heat, facilitate the operation.

The stamp-ores, consisting commonly of fine pyrites, sprinkled in the hornstone, and digging next to the veins, are roasted to make them brittle. But that causes a sensible loss to the proprietors, since the fire expelling the gold from the sweating hornstone in the form of a fine dust, this precious powder is too easily carried away by the waters of the stamp trough. This bad practice is entirely owing to the nature of their stamp-mills. Their pound-rammers or grind-pestels (*pockstempel*) being armed instead of iron (*pock-eisen*) with black or grey hornstones, cut into the requisite form, the roasting of their hornstones is necessary in order to make them

them brittle. In general, these stamp-mills are extremely imperfect. They are uncovered; accordingly every rain and flood carries away a good deal of their pulverized ores. Their water wheels are too small; hence arises a great loss of water. The dust channels are of the same width, and have no inclination at all; hence no such thing as a separating the richer from the poorer dust. I have shown all these deficiencies to the mill-master, and to convince him of the bad consequences of his stamping, I caused some sands from the first and last channel, and even from the flood or the brook that runs by, to be washed in his presence, which clearly shewed that all these sands are equally rich, and that the gold in the brook-sand is downright loss to the proprietors. But for such people old customary practices are above reason and conviction.

Four hours journey from *Zalatbna* to the east is *Abrud-banya*, the former seat of the upper mine-council. Red, and now and then grey schistous clay, covering our metallic rocks, appeared in all the mountains about *Abrud-banya*. The most remarkable ones are *Igric*, *Csetate*, *Boylor*, *Korna*, *Orla*, *Kirnizel*, and *Kirnik*. It is impossible for you to form an idea of their workings. The whole *Kirnik* mountain is from every part and side perforated with many hundred galleries, which



do not penetrate above some fathoms into its inner parts. Though this seems to be extremely bungling and awkward, it is less so in respect to the nature of its fissures and veins. Its numerous gold-veins are thin and short. The adventurers have allowed a field of three fathoms in the hanging and as much in the hading side. They commonly begin working on a vertical fissure, (*seiger kluft.*) which they work for six or seven fathoms; then it begins to dip and to be inclined, and insensibly it turns flat; that is, according to the nature of this mountain, it turns rich and yields native gold. But it continues scarce above two fathoms flat and noble; since suddenly it turns again and breaks off. The miner knows by experience, that now he is at the end of his hopes on this fissure; therefore he drops it for another, or searches in the old drifts, till he meets with some worthy remains of the old man. Hence that innumerable quantity of galleries or holes.

A *Roman* inscription, decorated with miner-instruments like ours, and found near this place, is an evidence that the *Romans* worked here.

Now and then extremely rich and showy ores are found; however, the proprietors, being often at work during several weeks without any success, are generally poor, and think themselves happy by  
getting

getting a week the scanty revenue of three or one  $\frac{1}{2}$  florin. The greater part of the inhabitants have no trade but this mining. The father is commonly buried in his mine; the son carries the ores to the mill; and the women take care of their stamping. The children gather the sands and the mud, which by rains is carried in the valley, bring it to the mills, and it generally yields some gold.

To have this singular *Kirnik* mountain the better examined, a gallery 300 fathoms in length is driven under it at her majesty's expence; but it has crossed only some deaf veins, has freed the workers from the day waters, and is left at present to their further disposition. The valley in which the stamp-ores are preparing is called *Voros Patak*. I do not exaggerate in telling you that there are in it above 300 stamp-mills, which set at work make a noise so as to be heard at an hour's distance. But they are as the common stamp and wash-works of the gipsies, without any covering, and with a single sand-channel. Instead of the stamp-iron they use here a grey hornstone from *Korosbanya*, which *P. Fridwalzky* is pleased to call calcedony. I cannot be convinced of the assertion of the mine officers, that they stamp and wash here without any loss; and you will rather agree with me, when I tell you, that the inhabitants of a neighbouring village, called *Kerpenes*, live entire-



ly upon the neglect of those at *Abrud-banya*. They dig holes, in which they convey the same brook which runs through *Voros-Patak* valley, and another which drives the stamp and wash-mills at *Bucsum*. The sands carried in these cisterns are auriferous, and pay richly the pains of a new washing at *Kerpenes*.

There are several other gold-mines in this neighbourhood as near *Bucsum* near *Abrud-Zeller* and in mount *Volkoi*. They consist generally of auriferous quartz-veins, left by the ancients, and now worked over again by the *Wallachians*.

Near *Zalathna*, in the *Barsa* and *Rusina* mountains, are *Peter Paul*, the *Three Kings*, the *Saints*, and some others. A great many more have been abandoned; and several of them yield auriferous lead-ore, nay, some native gold, but to no great advantage.

I cannot pass silently over the two mercurial mines at *Zalathna*. The first is to the north of this place, at an hour's journey from *Dumbrava*. The cinnabar ore (*cinabaris solida, textura squamosa, Squammis minimis*) breaks here in a vein, and in a matrix of quartz and sparr, inclosed in argillaceous black slate and sandstone. The vein runs from north to south, but is leaping, often a fathom thick, often compressed and deaf. The second is to the south in the *Baboja* mountain. Its ore is granulated

granulated cinnabar, digging in a vein, which runs in limestone. Probably the ancients dug here great quantities of cinnabar. At present the *Wallachians* seek here after the remains of the old man. Some societies however have united of late to undertake regular workings at *Babojá*. The mercurial ores are delivered to the furnaces at *Zalathna*, but the annual amount of clear quicksilver is not above three tons. They clear it by common distillation in retorts and alembics filled with water. If they told me truth, there is of late built at *Kisfalú*, near *Clausenburg*, a sublimating furnace for preparing sublimat-mercury

LETTER



## L E T T E R XIII.

*Nagyag, July, 1770.*

THE first mining place, which I met with the 16th on my excursion to the mines west from *Nagyag*, was *Csertes*. My father had here thirty years ago a rich silver-mine, called *Trinity*, which yielded a good revenue. But the situation of the ground making a deeper draining gallery impossible, and the want of sufficient water for the pumping-engines forced us to give it up. The mountains to *Csertes* consist of metallic-rock, covered with common argillaceous slate. But the *Bogaja* mountain, in which the above mine was working, consists of sound compact hornstone; the veins, which cross it, are very rich, and yield auriferous glass-ore, closely woven in the substance of the hornstone. The rocks are so remarkably hard, that even with blasting the works advance but little. *P. Fridwalzky* advised therefore in his *Mineralogy* to soften these refractory rocks by bacon suspended and set on fire before the drifts, *O! Sancta simplicitas!*

A new

A new society of adventurers has at present undertaken to drain this mine by a new gallery. But as it is to be driven a long way underground, and nevertheless cannot go any considerable depth, I am apprehensive that, though the drained part of the vein should consist of the richest ores, the expences will hardly be cleared.

In the adjacent hills are some gold-works, which in former times have given considerable dividends. These are not in hornstone (*petrosilex*) but in metallic rock.

The furnaces near *Csertes* are employed with the smeltings of the neighbouring societies. Want of water makes them often inactive.

The *Fourage* mountains near *Csertes* have had in former times many mines. For the greater part they are given up. The inhabitants of those parts assured me, that pieces of native gold, not lamellous but found as glass-ore, had been found there.

I went from thence to *Topliza*. The mountains consist there likewise of that grey argillaceous rock, mixed with mica, sheri or quartz grains, which I have presumed to call metallic rock (*Saxum metalliferum*.) They are covered with argillaceous slate. The veins are commonly a quartzous auriferous stone, and constantly running from south to north. Such is the vein of the *Nepomuck*,



*muck, Martinus, Rockus, Archduke Peter, S. Joseph, Mary's Annunciation, Florian, Francis de Paula, and the Holy Cross* in the *Magura* mountains. I was told that in *Nepomuck* native gold had been found immediately under the turf. Some of these fissures yield, besides their native gold, fine auriferous red silver ore.

In the *Matshire* mountains they drive at present a gallery, in order to drain some old works; and in the *Fisher* and other adjacent mountains are some gold-works, which now and then yield considerable pieces of native gold, but very often are dead and deaf.

In these *Toplitz* mountains the gold is often found in lead-veins. The same happens in the more westerly mines at *Fuezes*, whose rocks in the *Malula* hills are entirely correspondent with those at *Toplitz*. Near *Fuezes* I found a grey loose marle slate, instead of the common argillaceous shistus, superincumbent on the metallic rock. Being dissolved by the air, and considered as common clay, it had been employed to line the inclosure of a water reservoir. The water dissolved the lining, and the reservoir washed its enclosure away. Without enquiring the reason, the same marle was made use of again of late, and last spring the same accident happened. At last they were sensible of the blunder.

The

The consequence of this double unhappy expensive accident would prove very happy, if people would learn thence to conclude, that a mining officer should at least be acquainted with the common fossils and their qualities.

In *Clemens* near *Fuezes* there is native gold in felenite, or *gypso spatoso albo pellucido*.

On the opposite side of the *Malula* hills is *Trsztyan*, a place greatly renowned for its rich gold veins, and the magnificent showy pieces of native gold which are found here every day.

As they have received in *Transsylvania* a principle, that native gold is to be found only immediately under the surface of the horizon, I was highly desirous to examine this mine, hoping to find perhaps some arguments against that opinion, since for a very long time it has been worked to great advantage, and has produced an uncommon quantity of gold; which seems to me unaccountable, if the vein did not dip under the horizon. But the proprietor, Count *Stephan Gyulai*, scarce allows any imperial mine-officer to visit his mine; and all the works, being superintended by a *Wallachian*, are so barbarously bungling, that a man must be a *Wallachian* to hazard his life for his curiosity, and to slip down in the shafts wherein no such thing as a ladder or other proper assistance is to be met with.

Therefore



Therefore I was confined to examine the nature of the mountain, which consists of the same rocks as the *Fuezes* hills.

Better management would improve this noble gold-mine to a greater benefit for the proprietor. Being worked only by *Wallachians*, who never neglect any opportunity to pilfer, a good deal of the finer gold-ores may possibly be concealed by the workmen. Some years ago I saw myself in the market place at *Deva* a miner from *Trsfztyan* publicly selling fine samples of gold-ore. Though of late some severe ordonnances are published against this illicit thievery and sample selling, since it lowers the benefits of the royal gold office, it will however be very difficult to prevent the loss of the proprietors, because any miner may easily find an opportunity to sell his stolen goods to the *Corsars*. This sort of people ramble about in the remoter mines, buying from the proprietors their little provisions of stamp gold-ores, which by themselves would not bear the carriage to *Zalathna*. Having gathered their full load, they deliver and sell them to the royal office. This trade seems to be an advantage to the royal office, as well as to the poorer adventurers and proprietors, but it degenerates too easily into a commerce which proves pernicious to the richer works, as the *Corsars* have certainly no objection to purchase the stolen ores at a cheap price, and sufficient skill

skill to pound and to mix them with the stamp ores, which they are allowed to buy and to sell.

At night I reached *Boicza*. The mountains hereabout connect with those, which at my arrival in *Transsylvania* I found stretching on both sides of the *Maros* river. In general they consist from this place to *Deva* of metallic rock, covered with limestone, slate or sand. Some hills near *Boicza* are destitute of veins, consisting of blunted rocks, ferruminated by an argillaceous cement and resembling *Breccia*. The royal mine is working in a variety of metallic rock, differing from the common species by large feldspath pieces sprinkled in its substance. The uppermost or *Anna* gallery was driven in limestone, which is superincumbent on the metallic rock, and covers large valleys; but the deeper gallery runs in sandstone till it reaches the argillaceous rocks. The veins and fissures are bluish-leadglance, containing some gold and silver. I have some samples with gold immediately sticking on the blende and the lead glance. At the tenth fathom of the deeper gallery I found an argillaceous fissure nearly vertical, and in it a great number of blunted oval transparent calcareous sparr-bullets with opaque milkwhite stripes, resembling those of onyx.

Limestone (*calcarius albus particulis granulatis minimis*) is hereabout a detested stone among the miners,



miners, since it cuts their veins or fissures. This however should not disrecommmend the calcareous stones ; since, according to the theory of superincumbent mountains, it is of a more modern origin, and deposited in the valleys in which in former times the veins and fissures bassetted out. The blendish lead ores contain here commonly three ounces of silver, and the silver sixteen denarii of gold per mark. The stamp-ores are henceforth to be prepared in three stamp mills, which are at present building after the model of those at *Skerniz*. They stand on a sloping ground, one above the other ; pulverized ores to be washed in a great washing-house at the foot of the mountain, in which ten plane hearths will be set at work. A hundred weight of stamp ore gives eight pounds of metallic powder, the upper sort yielding six the lower two ounces of silver. The mark of silver contains sixteen denarii or one ounce of gold.

It was impossible for me to visit the many other mines at *Boicza* ; but I have got some of their ores as well as those of several still working mines in *Transsylvania*, and these you will please to take notice of by this following catalogue :

Auriferous pyrites in blueish clay ; *argilla communi plastica cærulescente*, from *Herzigan* near *Boicza*. They do not work here but on the old man.

Auriferous

Auriferous pyrites in black hornstone from *Ginel* near *Boicza*. Native gold to be found here in the same matrix.

Native hair-silver on lead-glance from the same place. The rock sticking to this sample proves to me that the *Ginel* mountains are metallic rock.

Auriferous quartz from the old works near *Ruda* and *Kriezur*.

Native gold in calcareous spar from *Staniza*.

Native gold in starry radiate antimony. From the same place.

Native gold in grey scaly cobalt (*scherven kobolt*). I assayed this cobalt, and had a gold grain left on the capell. The works at *Staniza* are in the *Jesuina* and *Dimbul* mountains.

Auriferous pyrites in indurated shivery black clay from the cross gallery at *Cajonel*.

Auriferous pyrites on quartz from *Gothelf* gallery at *Cojonel*.

Auriferous blende from the same place.

Auriferous lead-glance in hardened white clay from *Kisbanya*, where at present a company has united for working the lead-veins of that place.

Auriferous red silver ore on quartz from *Trajka* near *Trsztyan*. The vein runs in metallic rock.

Lead-glance in quartz from *Offen banya* near *Zalatbna*. Of late a company has united to work the large lead-veins which have been discovered



there. The old works are of the same kind, it is not known for what reason they were given up many years ago. *Fridwalzky's* pretended reason is fabulous. The nature of the rocks, that is to say, argillaceous clay, superincumbent on our metallic rock; the width of the veins; the great number of old bing-places; and the marks of thirty furnaces hereabout, have co-operated to raise the company into high spirits, and to undertake the works with activity

I got neither samples nor creditable accounts from the other *Transylvanian* mines. However, to make my accounts of the known gold-works as compleat as possible, I will give you their names, taken from *P. Fridwalzky's Mineralogy*.

At *Nagy-Almas*, to the west from *Zalathna*, in the *Rudile Baba* and *Petrasack* mountains, gold is found in antimony, and in a species of stone which is unknown to me, and which *P. Fridwalzky* calls *spathor pyrites*.

At *Pojana* in the *Vertes* mountains, in the same tract of land, the *Wallachians* hunt after stamp-ores left in the old works. In the year 1742 a blueish grey quartz vein with native gold was discovered by rain in the *Dimbul Kupiatra* mountain. It had its direction from east to west; but as in general the *Transylvanian* gold veins are very inconstant and short, so proved this likewise.

likewise. After a short run it shifted its direction, turned and broke off. I guess from *P. Fridwalzky's* obscure description that it was in hornstone.

At *Porkure* in the *Csetras* mountains the *Wallachians* hunt after stamp-ores; which they afterwards stamp and wash at their account. In the *Vallkurethe* mountains marks of gold-mines have appeared likewise.

At *Kirosbanya*, a mining place in the bailliwick of *Wissenburg* and the *Mayura* mountains, a vein two fathoms thick is said to be interrupted by small auriferous fissures.

I reserve the *Transylvanian* gold-washings for the description of my journey to *Upper Hungary*; and desire you to return with me to *Nagyag* for the sake of some iron and lead-mines on the other side of the *Maros*. The most remarkable mining place in the *Hunyad Comitatus* is three hours journey from *Vaida Hunyad* to the east, near a village called *Gyalter*. It produces a good deal of iron. The iron ores are found here, as in many other *Hungarian* iron mines in nests, or stocks six or eight fathoms large, which have but an irregular and uncertain direction to the south, and do not sink into any considerable depth. The *Kropilela* mountains, which contain these ores, consist of grey and brown argillaceous slate. The ores consist



of red and brown iron ocher, in which sometimes button-ore is wrapt up, covered with feather-like iron crystals, as the button-ore in the *bulf-gottes* mine at *Platten* in *Bohemia*. The workmen call this button-ore *iron-flowers*. *P. Fridwalzky* is a good deal wiser; he calls it antimony.

The smeltings have nothing particular, being done in a sort of small high furnaces; and the iron is beaten into bars in several hammer-works along the *Cserna*. The *Wallachians* and gipsies are in general blacksmiths and iron manufacturers. They use small and low furnaces, and blow the fire by portable bellows made of bucks skin. Their construction is very simple; consisting of a simple sewing of the skin of an iron air pipe fixed in the neck, and of two wooden handles, fixed to the skin that covered the feet. The antiquity of these iron-works appears by an inscription found near *Ostrow* and speaking of a *Collegium fabrorum*. Perhaps even the denomination of the *Porta ferrea*, or the pass on the limits of *Turkey* is hence derived. This remark and conjecture is entirely *P. Fridwalzky's*.

Nearer towards the *Maros*, and a village called *Kismunes*, have been found some lead-veins in argillaceous slate, which of late have been undertaken by a private company. On the road I found calcareous hills, filled with a great variety of  
turbinites

turbinites and other marine shells. These hills on the *Maros* are to be considered as the foot of the high mountains, which run by the *Haczeka* valley, uniting afterwards with the high *Granite*-mountains, between *Transsylvania* and the *Moldaw*.

There is hereabout but a single natural curiosity remaining which I cannot leave unnoticed. Near the door of the deep *Josephi* gallery at *Nagyag* I have found an hill about thirteen fathoms high, consisting of an innumerable quantity of regular pieces of metallic rock. They are flat, and about a foot in thickness. This hill cannot possibly have been heaped together by human hands, nor is there any old mine to countenance this opinion. Besides, these shivery stones are exactly fitted and joined one to another; are not mixed at all with any other species of stone, and speak at first sight that by some accidental cause they are split and cracked into so many regular fissures and fragments. But what accidental cause? A concussion subsequent to the exification of the rock seems to be a very probable one; but I have better reasons to consider these stones as volcanic productions. They are of a coarser texture than the common metallic rock at *Nagyag*, and are sonorous. I know that mineralogists will start many objections against this opinion, as in  
a great



a great distance no extinct volcanos are to be met with. Therefore I desire you would examine this shivery stone, and a similar species from the volcanic *Euganean* hills near *Padua*. Samples of them you will find among the *Transsylvanian* fossils, which I have collected for you.

LETTER

## L E T T E R. XIV.

Near *Foldwinz*, June 24, 1770.

FATIGUED by the heat of the day I arrived here, where, except some grafs for the horses, no accomodation is to be had for the passengers. Unable to swallow the four wine of my poor landlord, I drank a glass of water. I think of you, and write to you an abstract of my journey from *Nagyag*. I left that place yesterday. When I had passed the metallic rock-mountains, which are covered with slate, I got into a plain, now and then interrupted by argillaceous slate-hills; then I reached the *Maros* to the right. To the left near *Bobolna* we had mountains of ferruminated clay and pebbles, as those near *Boicza*. They seem to have been heaped and washed together by the *Maros*, since their sloping to the river is less indurated, and a piece of tile ferruminated with other pebbles, which I found near the road, is a good evidence of their successive and modern origin. The hills of the same nature, which are more to the north, and those at *Boicza*, which are likewise on this side of the *Maros*, had probably



bably the same origin, and accordingly this river seems to have shifted its bed from south to north and to shift it ever more since the plains on the other side do not confine it within constant bounds. Hereabout, but on the other side of the river, are the *Olapian* plains, times immemorial famous for their gold-washings.

The surface of these plains consists of sands and pebbles. After the removal of the turf and of the vegetable mould, this sandy stratum, two fathoms thick, appears. Times out of mind it has been dug out, and yielded gold by washing. It is superincumbent on argillaceous slate, which is destitute of gold. To the east and west it is surrounded by hills, which in the south connect with those that divide *Wallachia* from *Transsylvania*. To the north it is adjacent to the *Maros*. It seems to owe its origin to some inundation, perhaps even to the *Maros*. The gold cannot possibly be considered as produced in this plain; it is probably washed by the rains from the adjacent gold-fissures and deposited with the sands. This conjecture gains some credit, because gold has been of late washed with success in such places, which many years ago had been worked and washed out already.

In the night I reached *Carlsburg*, a fine fortress. It is my birth place, and I had here my education  
till

till the eighth year of my age. It is pleasantly situated in a plain, furrounded by argillaceous slate and limestone hills. I met here with an *Hungarian* nobleman, who was very well acquainted with the gold-washings, especially those in *Transsylvania*. He gave me the following accounts, which I communicate to you, since I shall have no opportunity to examine these washings myself. All the *Transsylvanian* rivers and brooks, nay even the sudden and momentary rain and mountain brooks are auriferous. But the *Aranyos* river is by far the noblest of all in that respect, and is compared therefore by the *Transsylvanian* Historians to the *Tagus* and *Paetolus*. The gold-washers are either *Wallackians* or gipsies. These gipsies are not in the least resembling those idle and lazy ones in *Hungary*. They are a laborious people, and honestly active for their livelihood. Some are strolling fiddlers and musicians; some blacksmiths; others deal in cattle and horses; and the greater part has the gold-washing business. They pay their poll-tax every year with some hundred pieths of gold; and sell a good deal to the royal offices. They have great skill in finding and tracing out those places where gold-washing is attended with success. Their tools consist of a board two or three feet wide, and four or five feet long, commonly edged on both sides with



with a wooden brim. Woollen cloths are spread on it, and the sands, poured with water upon it, leave the finer and heavier sediments in these cloths, which afterwards are washed in a great water cask, and then by the common severing trough separated from the gold. If the sands be mixed with coarser gravel, the board has deeper cross-furrows, in order to stop these coarser stones, and to examine them for gold, which often is found visibly sprinkled in their substance. Such is their manipulation at *Topansalva*, near *Abrubanya*, and all along the *Aranyos*.

Another practice common in *Transsylvania* is to dig pits, and to catch and stop in them the sand and gravel carriage of the brooks, in order to sever them from the gold-dust or ores. I have observed the same at *Kerpenes*; and it is practised at *Zalathna* on the *Ampoi* river, near the old mercurial mines, whose crriages contain a good deal of mercurial ore.

The third method is to fetch the auriferous vein rocks from the old mines, and to clear them from the gold both by pounding and washing. This method is generally practised where plenty of water allows it.

This morning I travelled over a fine cultivated plain to *Enged*. Here is a *Calvinist* academy, and some schools of that religion. The adjacent

ja-cent hills calcareous ; the whole place built of pale yellow sandstone ferruminated with lime. The sandstone, filled with plenty of petrified shells, and dug in the hills, which continued behind *Enged* to *Foldwinz*, and to the very place whence I write you these lines.

LETTER



## L E T T E R. XV.

*Clausenburg, July 28, 1770*

**U**NDER the most tremendous thunder and rain-storm, which I ever beheld in my life, I arrived the 24th at midnight at *Torda*. Behind the place whence I wrote you my last the mountains are ever ascending. From the top, whence I had a sight of the basin of *Torda*, I discovered a great many hillocks, superincumbent on this high elevated ground. Though I could not examine their nature, they consist probably of the same grey limestone which covers the valley, and stretches to the *Aranyos*. *Torda* is on the other side of this auriferous river; the salt works half an hour's distance from the town on an argillaceous slate hill, which is surrounded by a great many little hillocks, said to be calcareous, and proving at first sight that they owe their origin, together with the salt rock-mines, to former seas. The whole plain on this high ground contains solid transparent *sal-gemmæ*, probably superincumbent on schistus. I could not examine it myself, and the miners were too unconcerned to know whether

whether their salt-rocks have a basis of clay or of limestone, or of any thing at all. The turf and vegetable mould which covers them shews commonly white efflorescences of kitchen salt, which exposed to the sun tinge the whole surface with white. They are to be ascribed either to the evaporations of the ground, or to the rain water running over the salt-bing places.

There are several mines or shafts sunk in the same salt-rock stratum. Their construction is particular. As soon as a shaft is sunk and timbered in the upper earth bed, which is commonly from three to six fathoms thickness, they reach the salt-rock, and work down in it a conical pit, so that all the miners are employed on the same sole. The number of the workmen is [ increased in the same proportion as the cone widens. At first sight one might believe the whole salt stock through its thickness of thirty or forty fathoms consisting but of a single stratum; but on nearer examination it appears to consist of many accumulated parallel beds, of one or two foot thickness, which are either horizontal or undulating and separated from each other by a thin layer of clay scarce the thickness of half a line. This natural separation facilitates the breaking of the salt-rock, and is the more an advantage to the workmen, as they are paid only for those pieces which are eighty pounds, the smaller



smaller ones being thrown on the bing places among the rubbish. For a piece of the requisite weight they are paid half a groat; and whatever has the requisite bigness is carried to *Carlsburg*, whence it goes by the *Maros Hungary*. I descended with five gentlemen into the *Theresia* mine. Put all together in a wide sack of rope net-work, and let down in the drawing-shaft; the sack contracted by our weight so much that only our heads peep'd out. A miner was above our heads clinging to the rope which let us down, to avoid our clashing against the sides of the narrow shaft. This shaft is sunk ten fathoms through the hardened clay, superincumbent on the salt-stock; and a small gallery is driven on the surface of the salt beds to bring away the waters soaking through the earth and clay roof, in order to prevent their falling down into the works. Besides, there is a smaller shaft for descending and ascending of the workmen; but the works below being of a conical form, the ladders cannot possibly be fixed to the sides; accordingly they are fastened by iron cramps or ropes one to another, and hang free and swinging in the midst of the deep and wide cavern below. However, the workmen do not care, and being used to it, ascend and descend these thirty or forty fathoms on swinging ladders as unconcernedly

and

and nimbly as other miners in the most regular shafts. When we reached the opening of the salt-stock we hung free in our sack, and I saw with pleasure below me, in the depth of thirty-three fathoms, the many lamps of the workmen. I found in the mine the director of these salt-works, who had the politeness to shew and to explain whatever was worth seeing. I was agreeably surprized by a burning bundle of straw, dropt down the shaft. It illumined the whole cavern, shewed me its conical form, unsupported by any timber, and made me distinguish the undulating form of the salt-beds. The light was from every side reflected by the whiteness and brightness of the salt-rocks. I have examined the clayish earth, which separates their strata. It has a sourish taste, but an offensive disagreeable smell, like that of rotten cheese. It is tough like clay. The present sole of this work is fourteen fathoms diameter. The *Coloser* mine, of the same nature and form, is sixty fathoms depth, and fifty fathoms diameter.

Many old salt-pits are given up long ago. These are entirely filled with water, which they use hereabout for bathing. I was presented here with some transparent pieces of salt-rock with inclosed water drops; another piece contains moss. I got here likewise a great quantity of the *lapis numismalis*



*malis Transsylvaniae*, described if I am not wrong by *Bruckmann*. Gyps and alabaster is very common hereabout. Pray tell me what is the reason that these stones are for ever to be found in the salt-works? Might not the saline acid perhaps be changed into vitriolic acid, and thus gyps be produced? I have gyps from the salt-mines in *Upper-Austria*, and from the *Marmaros*, where it is found between the salt-beds.

After having satisfied my curiosity under ground, I saw the immense piles of rejected salt-rocks which are under the prescribed size. They are kept for no use; and severe penal laws forbid even the poor to make use of them. The reasons which they gave me for this unaccountable squandering away of so useful a substance, were as follows: That to prevent smuggling pieces of the same weight were given to the carriers, and that the abundance of the *Transsylvania* salt-mines did not seem to require any grudging, or sending the smaller salt-pieces in sacks or casks. This might do, if the world was only to last but a thousand years more; but good public œconomy takes care of the latest posterity, and disapproves any arbitrary and unnecessary destruction of an useful mineral as inhuman extravagance. Many hundred millions weight of rejected salt are thus exposed to dissolving rain and snows; and what vast quantities are spent  
in

in a similar way near and in the *Vizakna*, *Kolosser*, *Szekes*, *Deese* and *Paraite* salt-mines? Though *P. Fridwalzky* considers the *Transsylvanian* salt-mines as inexhaustible stocks, he could not digest this cruel waisting of useful materials, and he had in this *Mineralogia Daciæ*, p. 171, the fantastical idea, to mix these immense salt-masses with tartarus, and thus to change them into nitre, in order to make sublimate. However, there might be some chemical use of this waisting-salt. Might not saline acid be properly joined with urinous substances, every where to be had, and thus sal-ammoniac be produced? You know of the sal-ammoniac-manufactory of Mrs. *Gravenhorst* at *Bronswic*. Might we not possibly expect a greater advantage from our superfluous salt-rock pieces, than these gentlemen can get by their scanty and aqueous brine?

*Clausenburg*, two hours ride distant from *Torda*, is divided from this last place by a high mountain, consisting of argillaceous slate, and offering from the middle to the top a great many globular stones, three, four, and five foot thick. They consist of yellow sandstone, cemented with lime and filled with petrifications, such as I found stratified near *Foldwinz*. Some of these stone-bullets are closely sticking together; which supposes their having been connected when in a soft state.



This mountain stands completely insulated, and there is no higher mountain round about, from whence these bullets might have been rolled to this. Accordingly they seem to have been carried thither by the floods of the sea, whilst it covered this country. At the foot of this mountain lies *Clausenburg*, one of the finest and most populous cities of *Transsylvania*. The *Roman* monuments, quoted by *P. Fridwalzky*, and found hereabout, prove that in former times it was a *Roman* colony. The houses and even the walls, which inclose this place, are built of grey or yellow limestone, filled with sand and petrifications. In general the country abounds in them; however, I have not found any scarce species. The desire to converse with a mineralogist, or rather my curiosity, prompted me to visit *P. Fridwalzky*, living here in the college of the jesuits. His rooms are filled with ill chosen stones, minerals and petrifications confusedly piled up. They bear the mark of their possessor's confined and unconnected science. He is really a very industrious laborious man, but he has got together such confused ideas of natural-history, that I am apprehensive he never will be able to bring them into any tolerable order, or to distinguish the true from the false ones. This is rather owing to want of proper instruction and useful books, than to a deficiency

deficiency of his application or capacity. The desire to be useful led him to compile a *Mineral History of Transsylvania*; ignorant what science and experience is requisite to such a task. He supposed to have discharged his duty by giving the names of the mines, the length of the drifts, the depth of the pits, by compiling some accounts of mine-officers, a couple of charters and other monuments; and then, after all, telling his countrymen that this is a *Mineralogia Transylvaniæ*. No such thing as proper descriptions or denominations of the rocks, and their local connexion and variety, which would have been material. At present there is scarce any hope of his improvement. The good-natured *Transylvanian* noblemen look upon him as a great natural philosopher, praise his deep knowledge of nature, consult him, and by all those seducing undeserved distinctions hinder him from getting the better instructions by his masters in that part of science. Accordingly his future publications on Natural History will be but too much resembling the former ones. He seems to be sensible that his indigested accounts cannot recommend him to the esteem of true connoisseurs. His chief attention is therefore bent of late on other objects. He intends to make tiles from *asbestos*, paper from different vegetables, and borax from *stalactites*.



With such propofals he endears himself to some of the *Transſylvanian* noblemen, calls them his generous *Mecænas's* in proper humility, and is to have from the provincial ſtates an annual penſion of 300 florins, in order to realiſe his projects and to continue his diſcoveries in Natural Hiſtory. It is a great advantage for *P. Fridwalzky*, *in iſta loca veniſſe ubi aliquid ſapere videatur*. I deſired him to ſhow me the ſtone from *Gyalupopi* from which he propoſes to extract borax. It was a common calcareous ſtalactites. Then he brought me his *ſtannum ſiculum* which he mentions p. 104 of his Natural Hiſtory. It was a black cryſtallized blende (*black Jack*) from *Kapnik*, which never will yield any tin. At laſt he procured me a ſight of the cryſtal, with incloſed gold, which he deſcribes p. 177. As I did not conſider this phænomenon to be very extraordinary, I little fancied that even in this he ſhould have been miſtaken. But the pretended cryſtal was common glaſs, containing within its ſubſtance a painted gold garland, ſuch as at a few cruciers expence you might buy by thouſands at *Turnau* in *Bohemia*. All this proved to me that the gold grains in grapes, the liquid fluid gold, and many other fantaſtical ſingularities which he pretends to have ſeen, to have examined, or to have heard of, deſerve no credit at all.

LETTER

## L E T T E R. XVI.

*Nagy-Banya, Aug. 2, 1770.*

I SPENT two days in going from *Clausenburg* to this place; and I had no leifure either to see the iron-works at *Toroczko*, nor the lead-mines of *Runda* near *Bistritz*. I had likewise no time to spare for the salt-works at *Dees*, because I am to make great haste, in order to return to *Schemnitz* within the space of time which I am allowed to be absent. But I know by very good authority, that these salt-mines entirely resemble those at *Torda*, and that the salt produced is exported to *Hungary*. All the roads, and all the hills, which I passed, were covered by a pale yellowish limestone, containing many marks of broken shells. In some parts the micaceous slate, on which it is superincumbent, appeared naked above ground. *Nagy Banya* is situated in a valley, surrounded by a tract of mountains, which runs from the north to the east. It is a free and royal mining town, and was in former times, with its dependant mines, the constant domain and allowance of the queens of *Hungary*. In the ancient records it is



often called *Rivulus Dominarum*, on account of a brook which runs along the northern hills, connected with the *Carpathian* mountains. From such records it appears, that its mines have been worked already under King *Lewis I.* in the year 1347. King *Matthias Corvinus* left to the city, in 1468, the mint and the mines for an annual lease of 13000 gold florins. In the *Hungarian* laws, from 1519, two chambers of the royal revenues from mines are mentioned, one at *Kremniz* and the other in *Rivulo Dominarum*. This and the very name of *Nagy Banya*, which is the *great mine*, proves the antiquity of its successful works. The ancients seem to have been very skilful in smelting and parting their ores. One hundred weight of clear ore is said to have contained from 79 to 112 ounces auriferous silver. The poorer and mixed ores were in those times ground in common mills; and one hundred weight of the old slags yields scarce a drachm of silver. From the year 1526 these mines decayed by a successive variety of accidents, war and rebellions, till in the midst of the last century they were given up entirely. Such was their abandoned state till Baron *de Gersdorf*, one of the most intelligent mining-officers of the imperial states, proposed the renewal of the works in the *Kreuzberg*. Count *Gotlieb Stampfer*, whose character and mineral science you  
are

are acquainted with, ventured himself by a small gaping of an old gallery down into the mine, which he found drowned by water. With great danger he shipped in a sort of skiff over the depth to the sides of the vein, and gathering there some rich ores, he greatly encouraged a subscription for draining these works.

To this purpose a deeper gallery was resolved; and the success being unquestionable, and the situation as favourable for smelting furnaces and stamp mills, as the account of the ancients, the proprietors pursue the undertaking with unwearied zeal, and have been these last seven years seriously engaged with their gallery.

It was at first driving for eighty fathoms in grey marlestone; then followed dark grey hardened clay, and at last the metallic rock. This is the only mine at present working at *Nagy-Banya*. Several other fissures however are working by poor adventurers, but at present without success. In the year 1748 a board of surveyorship of mines over several works, formerly belonging to the chamber of *Kasbaw*, was established here; and ever since, the neighbouring mines at *Kapnik*, *Felso-Banya*, *Fekete-Banya*, *Lapos-Banya*, and *Mis-Banya*, have been constantly in a more thriving state. I shall examine all these mines, and set out to-morrow for *Kapnik*, which will procure me materials for a longer letter.



## L E T T E R XVII.

*Nagy-Banya, Aug 6, 1770.*

**H**AVING the choice of all the places belonging to the *Nagy-Banya* inspection, *vicit amor patriæ*. I went to *Kapnik*, a royal mine, in a rough country surrounded with mountains, and situated on the furthest limits of *Transsylvania*, formerly belonging to the *Transylvanian* chamber, but of late subjected to the direction of *Nagy Banya*. It is four hours journey from this place, and the cliffs, which I met with going there, consist of large naked granite-rocks and argillaceous glimmering slate. *Kapnik* lies in a valley. According to an old tradition the *Transylvanian* princes are said to have opened the first mine towards the end of the sixteenth century. Its name the *Princes-gallery* (*Fursten-Stolln*) supports that tradition. The annual produce consisted then of four or 500 marks of silver, containing some gold. But the prevailing ground-waters put a stop to the works, which at last ceased entirely. In 1748 they were resumed, which was occasioned by the *Josephi* mine, as having been sold to the chamber by the  
impo-

impoverished proprietors for the trifling sum of 800 florins. *Kapnik* has at present the advantage over many other mining places, on account of many unattempted mountains, in which of late have been discovered the *Maria Hulf*, *Barbara* or *Josepb*, *Josepbina*, *Kapnik* or *Ungarstoln*, *Erzback*, *Theresia*, *Clemens*, *Peter Paul*, and *Christopher's* veins, each working by different companies. All these veins run from north to south, dipping from west to east. The rock of these metallic mountains is a white argillaceous compact stone, resembling our *Saxum metalliferum*, except that it contains some spots of white stone-marrow (*lithomarga*). The rock of the deaf and barren mountains hereabout consists of a blueish trap, striking some fire with steel. In some places both these rocks are covered with micaceous clayish slate. The princes-gallery vein is pursued already a length of 427 fathoms. In the present drift it is narrowed a little by the skirting rocks grown harder. Its common breadth is four or five fathoms. It consists of rosy-coloured feld-spath sprinkled with fallow silver ore. The pure fallow ore is melted separately; and the feld-spath goes to the stamp-mills. In the hading side of this vein runs a lead and blende-vein. Fourteen fathoms deeper are some smaller drifts working; but the rest is drowned in water, which the ancients



cients worked out by pumps, and henceforth will be carried off by the deepest gallery, which is to cross and to drain all the veins together. *Petri Pauli vein* produces an auriferous white quartz, sprinkled with fallow silver-ore, and now and then some nests of a pale yellowish pure scarce coherent auriferous calcareous earth. The quartz contains grey plumose and pale yellow antimony, which is likewise found next with the vein in white clay, but then in coarser crystals. I was told that the vein grows richer in gold wherever antimony happens to be found in it. I observed here on the hading side of the vein a crystallisation, whose surface was all over covered with small cubes. You know how curious I am of crystallisations. I endeavoured therefore to separate it from the vein, but found that this whole mass of cubes consisted of a calcareous unpetrified earth. I observed the same phenomenon some weeks before I set out on the old *Anthony of Padua-Stolln at Schemnitz*, where in the deepest sole I found a large cube, which at first sight I believed to be a hollow spar-cube, such as I have many in my cabinet. When I touched this crystallisation the smaller cubes, which covered the greater one, were found incoherent, nay liquid, and the greater cube yielded under the pressure of the finger, and the water contained within run off.

off. These facts prove that crystallisations are continually producing in the humid way; and accordingly the many hollow crystals, which you have seen in my cabinet at *Shemnitz*, have been in the beginning liquid lumps, whose surface crystallising in forms convenient to their saline nature, successively hardened and left an empty crystallisation after the water was evaporated.

The *Maria Hulf vein* is a hardened auriferous clay, sprinkled with pyrites, washed in the washing-mills.

The other veins consist of a pale reddish auriferous feld-spath, commonly sprinkled with fallow-ore. The redder, that is to say the more irony it is, the more auriferous too. Most part of these fissures are separated from the deaf rocks by a soft argillaceous skirt (*saalband*.) The deepest gallery at *Kapnik* has been driven already 700 fathoms in length into the above white metallic rock. It was begun by Baron de *Gersdorf*. The veins crossed by it are large and fine; but their auriferous quality diminishes in the depth. This gallery is to be lengthened 500 fathoms, and then it will drain the remotest *Fursten Stollen-vein*.

An hour's ride from *Kapnik* in the *Rota mountain*, is a private mine, which I examined likewise. The vein runs between a green indurated  
somewhat



somewhat calcareous rock, which is on the hading; and the white metallic rock, which is on the hanging side. It consists of white quartz, mixed with blende and lead-glance. It is auriferous, nay the gold appears often in visible native lumps.

The stamp-mills are in general of the same construction as those in *Lower Hungary*. However, the present upper inspector, Baron *Smidlin*, has built one with six pestels and double gutters. This really does a good deal of work in very short time; but as the pestels go very briskly, and as more water is spent and to be given in the trough, I do not conceive this construction to be any great advantage, since the impetuosity of the briskly running water does not permit the fine gold-dust to precipitate in the canals, and consequently a good deal is carried away.

They have here three smelting places with eight furnaces, both for the royal and for the private mines; the private reguli to be sold in the royal purchase office, and the whole produce of gold and silver to be coined in the royal mint at *Nagy-Banya*. Their method of smelting is hardly in any thing different from that used at *Shemniz*. Baron *Gersdorf* tried here an experiment, which deserves your notice. He ordered a quantity of the rejected salt-rocks to be fetched from the neighbouring bing-places at *Marmoros*,  
and

and when the smelting furnaces were going, some troughs full of it to be thrown upon the works, according to the practice of the assayers, and in order to prevent the silver flying away in the fire. However, the effect did not answer the expectation; rather the silver was lessened one half per hundred weight. But this was owing perhaps either to the neglect or the malice of the common smelters who are natural enemies to any novelty.

LETTER



## L E T T E R XVIII.

*Nagy-Banya, Aug. 22, 1770.*

**M**Y long silence is the consequence of an unhappy accident, which was very near putting an end to my life. To examine the common firing at *Felfo-Banya*, and the great effects produced by so small an expence of wood, I visited the great mine when the fire was hardly burnt down, and when the mine was still filled with smoke. An accident made me tarry somewhat longer in the shaft, by which the smoke went off. In short I lost my senses, and fifteen hours after I was restored to myself by blisters and other applications. My lips were swollen, my eyes run with blood, and my limbs in general lamed. Without the assistance of a skilful young physician at *Nagy-Banya*, and the great care of the upper administration's inspector, Baron *Gerham*, in whose house I lodge, you would have been deprived of your friend; and the question is still whether he is to be saved. A violent coughing and acute pains in the loins, which alternately put me on the rack, are I fear more than sufficient  
to

to destroy this thinly framed machine. If that should be the case, then my friend I desire you to have my name at least inserted in the Martyrology of Naturalists.

*Felfo-Banya* is one of the eldest mining places. Formerly the inhabitants had no trade but mining; and in that respect they got from King *Lewis II.* a grant of freedom, dated 1523. The public troubles, which put a stop to all the neighbouring works, did not affect these, which continued uninterrupted to the year 1689. In 1690 the emperor *Leopold* bought the works at *Felfo-Banya* for 25,420 florins, granting by public charter eternal freedom from any taxes to the inhabitants: the mines have been ever since in a thriving state. At present the *Borkul* and the *great mine* are the richest. Times immemorial the rock, consisting of grey hornstone (*petrosilex*) is worked by firing, which in the upper soles has caused tremendous caverns threatening ruin, and not to be fastened by any timber. In these ruins, or rather in this *old man*, several private adventurers hazard their lives in searching after remaining ramifications of stamp-ores. I got from such an old cavern a sort of stalactites, which seems to me extremely problematical. It is very light, resembling in colour a red yellow amber, vitreous and glossy where broken, resists acids and the fire without giving any smell.

The



The *Borkul mine* has its hading and hanging sides of the above hornstone. The vein-rock is zinnopel, different from that in *Lower Hungary* only by less hardness. The vein is one fathom more or less, and contains stamp-ore, which yields but two ounces silver, the mark of silver yielding twenty denarii gold.

The great mine has likewise a vein like that of the pacher-stoln at *Shemniz*. In some places it is six fathoms wide. I went with horror over the ruins and the large rocks detached from the floor, till I reached the third sole, which is less ruinous. On the fourth sole a fissure coming from the hading side, crossing the main vein in an acute angle, strikes it dead. The stamp zinnopel of this vein contains two ounces of silver, and the mark of silver forty denarii or two ounces and a half of gold. Some times they meet here with ore of sixteen ounces silver. In a hanging fissure of this vein is found fine red, found or crystallised sulphur, (fandaraca) on white milky crystallised quartz; the same sort of native sulphur on yellow orpiment; white coarse cubic pellucid fluor with inclosed sulphur; grey plumose antimony; the same on quartz-crystals pointed on both ends, and closely sticking together; red and grass green antimony; grey coarse radiated antimony on white pellucid rhomboidal prisms of fluor two or three inches in  
length,

length, which are perforated by the antimony, and prove that these minerals, however different in themselves, crystallised at the same time. I got likewise from the same vein red fine crystallised magnesia.

I have told you already that the mine is worked by firing. But this firing is different from that practised at *Goslar*, and at *Schlackenwalde* in *Bohemia*. The large ruinous caverns produced by it in those places, as well as on the upper soles at *Felfo-Banya*, caused the proprietors to think of a more profitable and less ruinous method of firing. They sink their shaft by chissels, hammers, boring and blasting, to six, nine, twelve, fifteen fathoms. To contrive then a drift, a cut one foot high and deep is made to that side which they want to work. In it they place an iron grate, which they call the *pragel cat*, and it is to be covered with a layer of small pieces of wood, about an inch thick and one foot in length, and then to be set on fire. This softens and loosens the rock, which by iron levers is taken off from the sides and the roof, and facilitates the further firing, so far that no side-cut is requisite. The drift being widened by this method, and the vein over head to be obtained, they begin firing at its sole, covering it by a bed of two or three feet of deaf rock or stamp-ore, and lining the hading and hanging sides with

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a wall



a wall of the same rocks, in order to prevent the flames spreading that way, and causing unnecessary caverns. Then they proceed to set heaps of wood as noticed before. Such a heap consists of about twenty-one or forty-two pieces of wood, three and three in layers a-cross till they reach the roof. Twenty-four heaps requisite for a length of four fathoms ; and for these, together with the breaking down the loosened rocks, are paid to the miner twelve one-half cruicer and eight ounces of lamp tallow. By this method only the top of the flame works on the rock. They have an hundred skilful manipulations to direct it to the hanging or hading side, where they want it most. The loosened ores are left on the soles, new soles made of them, new firings set, and thus continued till the whole vein between two soles be broken down. The vein being extremely large, they begin firing in the hanging, going on to the hading side on the same level a-cross the whole vein. The stamp-ores thus loosened are left in the mine as a magazine till they are in want of them, when they are carried under the shafts, and thence to the stamp-works. Thus the ore is procured at a cheap rate, a fathom of a drift by firing costing not above fifteen florins, and requiring only two or three florins value of wood. The solidity and hardness of the rock is an advantage to this manner

manner of working; cracked and broken mountain or vein rocks would be less acted upon by fire.

The vein rock of this large mine is zinnopel, a jasper-like stone, extremely hard, scarce to be conquered by the chissel and hammer, and hard to be blasted. However, I cannot be convinced of the great advantages of this apparently cheap and efficacious firing. Perhaps you will agree with me.

1. Whatever care be taken in lining the sides it is impossible to prevent the flames from loosening the rock-skirts of the vein, which, unsupported by timber, of course break down, and produce those unavoidable and dangerous caverns.

2. The fire volatilising and dissolving the pyrites and the semi-metallic part of the ore, makes the air of this mine extremely unwholesome, and affects the health of the poor miners, who seldom arrive to any advanced age.

3. The miners cannot, on account of the fire and smoke, work more than three days in a week.

4. The ores being pyritical, the fire carries too much sulphur away, which of course lessens the lech-stone and the scorification of the unmetallic parts.

5. It produces likewise an unequal stamping; since the fire affects the ore in a very different



manner, calcining some and leaving many more found and unhurt at all. In short, a well directed cross or oblique working would be, according to my opinion, preferable in many respects to this firing.

The great mine is at present sunk 70 fathoms deep. Its vein runs in a metallic rock; and I am inclined to believe that the upper drifts are driven in superincumbent hornstone. The many fragments among the rubbish of the bing-places make me believe so.

The whole mountain of *Felso-Banya* is under-driven or underworked by a deep gallery 454 fathoms length. The ground waters drained by two pole-pump-engines (*stangen-kunste.*)

The royal stamp-mills at *Felso-Banya* are of a good and regular construction. Those of the private companies are but too much resembling to the common bungling stamp-works of the *Transylvanian* gipsies

The smelting places are, one of six furnaces, royal; the other of two furnaces, the property of the city. The gold and silver produce to be delivered into the royal mint.

Companies who work still for hope of a dividend have for a mark of their silver 21 florins 20 crucers; and for their gold  $77\frac{4}{5}$  ducats; but those who get a dividend, or for other reasons are deprived

prived of the higher tarif, are paid only 17 florins per mark filver, and 75 ducats per mark gold.

The unhappy accident which befell me here deprived me of the pleasure to examine the other works and the salt-mines at *Marmoros*. What I know of them is as follows :

The salt-mines at *Marmoros* are furrounded with micaceous clayish flate, which continues to the granite-rocks of the *Carpathian* mountains. It contains thofe fine pellucid octangular alum-formed quartz cryftals, which, carried by the rains into the brooks, are gathered there and fold under the name of *Marmaros* ftones. They have a confiderable hardnefs and natural polifh. In the falt is found pellucid, white, fine ftriped gypfum.

*Fekete-Banya* is a hamlet belonging to the city of *Nagy-Banya*. In 1645 above two hundred miners are faid to have been employed here for gold and filver; but at prefent it is a deferted place. However, in 1752 the city of *Nagy-Banya* opened a mine, which to this moment is not very fuccefsful.

*Lapos-Banya* is a metallic mountain, belonging to Count *Karoli*, and is divided into the *Miz-Banya* and *Sargo-Banya* mines. Thefe laft have large ftamp-ore veins, running in metallic rock,



and richer in gold than in silver. Now and then there is some lead-ore.

*Miz-Banya* has likewise copper. The gold and silver produce to be delivered into the royal mint at *Nagy-Banya*.

In *Olalapos* have been of late discovered some rich veins. I have from them a sample of zin-nopel, sprinkled with native gold.

Near *Illoba* is native copper sticking to lead glance. In the *Szamos* river herrings are said to be fished now and then, as has been assured to me by eye witnesses. Near *Nagy-Banya* is a mineral well, frequently used by the inhabitants.

If you knew how much I have suffered to finish this letter, you would consider it as the greatest proof which you might expect of my friendship.

LETTER

L E T T E R XIX.

*Schemniz, Sept. 5, 1770.*

**I**T is impossible to tell you what I have suffered in my ten days journey from *Nagy-Banya* to this place. I was commonly carried into the coach and out again. Any stone in the road, any jumping of the coach doubled my pains. The dry coughing, which I cannot get rid of, does not permit me any rest. Under such circumstances it was impossible for me to examine the mountains; and commonly the road went over plains in which I had the *Carpathian* mountains to the right, and the *Theissa* river to the left.

*Schmolniz* is on the promontory of the *Carpathian* hills. I should have strayed too much from the road if I had gone there. Besides the recovery of my health, if any to be hoped, did make my haste home necessary.

Near *Tockay*, in the fields and the vineyards, are found pieces of vitreous black and blueish lava, *Pumex vitreus Linnæi*, commonly called hereabout *lux-sapphires*. I did not see hereabout any mountain, which might be supposed a volcano in former times. The hill, which is so famous for producing



ducing the noble *Tockay* wine, consists of argillaceous slate, and does not manifest any other volcanic marks. This makes me believe that these lava pieces have been rolled down and washed from the *Carpathian* hills, in which such lavas and native sulphur are very common.

A days journey from *Altsohl* begin the hills, which to the right stretch in the *Luptan* district, and thence join with the *Carpathian* mountains. Here I could not bear the jolting of my carriage; I was forced to step out and to creep on very slowly. I observed vast quantities of loose granite pieces. Probably some of these mountains consist of granite; but as far as I might observe in passing by they are in general covered with argillaceous slate. Some lead-mines are working here; and as they told me some copper-mines too.

When I reached *Shemniz* the account of my accident arrived likewise; and as report heightens matters, I was said to have not survived it. My arrival was therefore a welcome consolation to my family. Among a great many letters, yours were opened first: I rejoice on your happy return into your country. I have partly satisfied your demands by the accounts of what I have seen and observed; but I do not know whether I shall be able to give you a compleat theory of the nature  
of

of the *Hungarian* mountains. However, I will endeavour my best in one of my next, and for the present I shall entertain you with the works at *Smolniz*, as described by me some years ago, when I wanted principles and experience for such a task, and when I little thought that such observations might prove an advantage to Natural History.

*Smolniz* is a celebrated mining place, belonging to the royal domain, situated in the district of *Zips* on the foot of the *Carpathian* hills. It has very noble copper-works, known in the times of Count *Zapolia* and *Bathori* under the emperor *Ferdinand* III. The *Zips* county and *Smolniz* devolved to the Counts *Csaky*, who in general lett the mines and the copper trade to foreign tenants. About the year 1671 *Francis* and *Stephen*, Counts *Csaky*, divided their county and the *Smolniz* mines in two equal parts; but *Francis* having engaged in count *Tokely's* rebellion, his part was forfeited to the crown. But the imperial chamber had no proper idea of this mine, and accordingly left this part to several private tenants, and in 1684 to the comproprietor count *Stephen Csaky*, at a yearly rent of 4000 florins. Three years after the chamber worked this mine at a common expence with count *Stephen*, and its share of the annual dividend was 14831 florins. This opened  
the



the eyes to the chamber, and made it think of the acquisition of the other part, which was obtained by an exchange in the year 1690, when the confiscated part of the county was returned to Count *Stephen*, and he prevailed upon to renounce his part of the mine, and the hamlets *Smolniz* and *Stoofs*, into the possession of the imperial chamber. Since this transaction the chief mines at *Smolniz* were royal estates, under the direction of the chamber at *Kashaw*; however, by want of proper principles, they could not be brought to any remarkable dividend. Therefore, in 1748, a formal general direction was established here, and the works were entrusted to a man of experience. The mines belonging under the general direction of *Smolniz*, are *Smolniz*, *Stoofs*, *Swædler*, *Einsiedler*, *Gollniz*, *Krumbach*, *Borathshod* or *Wagendrussel*, in the county of *Zips*, *Under* and *Upper Mezenseiffen* and *Jossaw*, in the *Abavira* district; *Tobshaw*, *Rosenaw*, in the *Gomorha* district; *Iglo* or *Newdorf* and *Wallendorf* under *Polish* jurisdiction.

The mountains at *Smolniz* consist of a blueish glimmery argillaceous slate, in which the three veins at *Smolniz*, called the middle, the exterior lying, and the exterior hanging vein are running in hour six in the morning, dipping to the horizon in nearly seventy-five degrees. Hence it appears

pears that they are parallel. They are about twenty fathoms distant from each other; in their bendings they are still nearer. The fissures between these veins are of no remarkable metallic value. The veins are subject to leaping, running sometimes dead a great length, and are affected in their run even by the least change in the situation or nature of the skirting rocks. These changes in the situation of the rocks are owing to small fissures, which cut the run of the vein in a different hour or angle, and are called here *kleins*. By long observation of these cross-fissures, and their effect on the main veins, the following rules have been laid down:

If the cross-fissure be coming from the east, it drives the vein into the hading; if from the west, it pushes the vein into the hanging side, where accordingly it is to be found.

Fissures in hour nine or twenty-one, and dipping to the east or the north, are called here *irregular* and *refractory* ones; *regular* fissures in the contrary are those that keep the above run and dipping of the main veins.

Regular fissures, falling in with the vein, push it into the hading; but irregular ones into the hanging side.

Though these cross-fissures or *kleins* very often interrupt the run of the vein, they are however  
requisite



requisite to enable them, as generally they are deaf where these cross-veins are wanting.

The middle vein is the richest. The second in rank and value is the hanging; and in respect to those the lying vein, as running beyond the mountain in the valley, is poor.

The rock of these veins is a dark grey clay, commonly mixed with quartz, but very seldom with sparr. Generally the quartz begins and ends the ores.

The argillaceous slate between the veins contains frequently considerable nests or lumps of pyrites. I have met with such a lump, improperly called here a pyrite-stock, in a depth of fifty-seven fathoms, between the middle and the lying vein. They are rich of sulphur, and contain two pounds of copper in a hundred weight.

The ores are generally yellow copper-pyrites, either superficially variegated, or yellow and sound or sprinkled in glimmery dark-grey slate. Besides these ores, whose richest species contains about twelve pounds of copper, the mines at *Smolniz* produce annually about an hundred thousand pounds of cemented or precipitated copper.

The water which soaks through the fissures and veins is impregnated with copper-particles, dissolved by the vitriolic acid. To impregnate it still more, it is led into some old shafts, thence  
raised

raised by pump-works, conducted through several bing-places, and then poured in canals, which are dug near the shafts and filled with old iron. The vitriolic acid nearer related with the iron, is attracted by it, and accordingly precipitates the copper under the form of a soft powder. If the cement waters be strong, this powder or sediment is every third day separated from the iron, to prevent its being incrustated with copper, which would hinder its further dissolution. It is observed that the copper precipitation succeeds sooner and better in those canals, where the vitriolic water falls with some impetuosity on the iron. Every month the copper sediments are gathered in the canals, the iron cleared and put again in the water, till it be entirely dissolved.

Another equally profitable work is the picking up and washing of the bing-rubbish, consisting either of the neglected ores of the ancients, or of those, which having been thought unfit for separation in the mines, are carried to the bing-places. These places are examined, the found ores separated from the deaf rocks, and the copper sprinkled slate pieces washed and sieved as at *Shem-niz*. The remaining unshining pieces go to the mills. This business is carried on by children, servant maids, and old maimed miners, and produces every year about 60,000 pounds of copper.

The



The stamp-mills are of the same construction as those in *Lower Hungary*.

Those ores that are too sulphurous are by roasting separated from the sulphur. Several sulphur furnaces are built for that purpose. They are from three to six fathoms in length; from one to two fathoms deep, and two fathoms high. Commonly they have thirteen windows; and each window several openings, by which the smelted sulphur runs out. The bottom of these furnaces is according to their bigness filled with three or four fathoms of wood; these wood layers are covered with some carts of charcoal; then comes a layer of found sulphurous ore one foot thick, and this is covered with alternating wash-ore-beds till the furnace be filled. The wood below is set on fire by a wood canal vertically set across the ore-beds. Such a sulphur-furnace contains about 500,000 pounds of ore, which continues burning twelve or fourteen months. If the sulphur ceases running from the openings, canals are dug in the upper covering of the furnace and paved with flat stones. These canals, and wooden conductors laid in them, are led to a stone reservoir; and as the rising sulphur steam is caught in the conductors, and cooled in the reservoir, a greater quantity of sulphur is got by this method than by the former. The depuration and sublimation of it  
into

into *flores sulphuris* are known practices. The annual produce or saving of sulphur is about 200,000 pounds.

The ustulated pyrites serve here likewise in a vitriol manufactory. When still warm they are put in tubs with water, elixivated into a brine, and this boiled and evaporated in lead pans, which produces a blue-greenish vitriol, but the want of sale makes this manufactory less considerable than it might be under more favourable circumstances.

The common copper-ores require ten different roastings, one raw, and one black-smelting; after which they are refined with some lead, as not bearing the expence to part the little silver which they may contain.

The richer silver-mixed copper-ores are parted as in *Lower Hungary*, and yield at a medium from twelve to 1400 marks of silver every year.

*Stoofs*, in the district of *Zips*, is a dependant place of *Smolniz*, and furnishes yearly about 500,000 pounds of iron, which for a great part is consumed by the cementation works at *Smolniz*. The iron-veins are here running in slate; the ores consist of brown or red iron-ocher, in a greater depth hardened into an iron-coloured found-ore, *Hæmatites cærulescens*. It contains now and then some nests of yellow copper-ore.

*Swadler,*



*Swadler*, a market-place, is surrounded with large forests, and a great advantage to the royal chamber. The furnaces in the midst of these forests smelt and refine every year about 200,000 pounds of rose-copper. The company of private adventurers work here in rich copper veins, inclosed in glimmery argillaceous slate, which every year produce above 400,000 pounds of fine copper.

*Einsidel*, a place belonging to Count *Csaky*, in the district of *Zips*, has rich copper-veins, which in former times produced considerable dividends, but for want of wood are but slowly working at present. However, they yield and sell every year to the royal purchasing office about 200,000 pounds of copper.

*Golniz*, in the same district, likewise belonging to Count *Csaky*, is in time anterior to *Smolniz*. It has two rich copper veins, let to several companies. The royal chamber has large shares in them, and some considerable independant mines.

The veins run to the east between horn-slate for a length of 900 fathoms. They dip into a considerable depth. The vein rock is grey quartz mixed now and then with spar. They yield yellow copper-pyrites, and grey copper ore, called hereabouts white ore, which contain fifteen pounds of copper per hundred weight, and from  
five

five to twelve ounces of silver. The whole annual produce of this place is about 600,000 pounds of copper.

*Krumbach*, in the same district, belonging to the same master, has iron veins in argillaceous slate-rock. In fundry places of this manor are rich copper veins, which annually produce about 200,000 pounds of copper.

*Boratshod* or *Wagendrussel* and its dependencies produce about 300,000 pounds.

*Under-Mezen-Seiffen*, *Jossaw* and *Upper-Mezen-Seiffen*, in the *Abavira* county, are three mining places belonging to the convent of *Premonstratensians* at *Jossaw*. This county is contiguous to the *Carpathian* mountains; the ground, consisting of argillaceous slate, rather working for iron than for copper-veins.

*Topshaw*, in the county of *Gomor*, on the river of *Gollniz*, has two capital copper-veins in argillaceous slate, worked by private companies. The different mines, belonging to this bailiwick, deliver annually about 100,000 pounds of copper to the royal office at *Smolniz*.

*Rosenaw* belongs to the Archbishop of *Gran*, and is situated in the county of *Gomor*. In the territory of this place are copper, gold, and antimony veins. The large old bing-places at *Zingobanya*, near *Rosenaw*, speak rich old copper-mines.



Some years ago they have been taken up again, and yielded good copper-ores, containing some silver; but the adventurers being unable to afford the expences of pump-engines the works are dropt. The gold-veins discovered some years ago are dropt likewise. The four antimonial-veins run in hornstone-slate. The ore is commonly found granulated and grey antimony; it scarce ever appears in crySTALLINE or plumose forms. Near *Krasznaborka*, in the county of *Gomor*, is a rich quicksilver-mine, which yields fine cinnabar-ore.

*Iglo* or *Newdorf*, in the county of *Zips*, is one of the thirteen towns which the Emperor *Sigismund* pawned to the crown of *Poland*. It has rich copper-works.

*Wallendorf* likewise pawned to the *Polish*. The mines belonging to this place work still in hopes of a dividend.

The buying of the copper produced in all these places is a royal prerogative, according to which the different private companies are obliged to sell their copper in the royal office at *Smolniz* at different prices, settled according to the different circumstances and the different goodness of the copper. These prices vary from twenty-nine to thirty-one florins; but the *Iglo* and *Newdorf* copper sells thirty-two florins thirty cruicers. Three months after delivery the companies are paid in ready

ready money ; which regular and constant sale has brought these *Upper Hungarian* copper-mines into their present flourishing state. The produce of the private companies consists every year in 1,400,000 ; but that of the royal mines of 700,000 ; in all of 2,100,000 pounds of copper.



## L E T T E R. XX.

*Skemnitz, Sept. 7, 1770.*

YOU will not expect a compleat history of the *Lower Hungarian* mines, their origin, works, engines, furnaces, œconomy and produce; that would be a work of some years and of some volumes. Besides, you have been here and seen and examined yourself. You have read Mr. *Severini's* treatise of the ancient inhabitants and the origin of the mines at *Skemnitz*; and you may expect an account of the *Lower Hungarian* engines from Mr. *Poda*, who is resolved to give it to the press. Perhaps a description of our subterraneous and metallurgical-works might appear likewise, if the imperial order be brought into execution. It is, that the professors of our miner-academy are obliged to penn down proper hand books for the disciples, which are intended to be published at her majesty's expence. I want only to remind you of the nature of our rocks, of the rule of our veins, and of some observations thence arising, in order to support a short theory of all the *Hungarian* mountains, which

which to comply with you, I have resolved to sketch out.

The promontories of the hills, in which the noble veins at *Shemnitz* are running, raise on the borders of the *Gran* river, where they consist of slate, which afterwards unites with a harder, argillaceous grey rock, mixed either with fherl, or quartz, or calcareous spar-grains.

This rock, which hitherto I constantly have called metallic rock, is the common mountain-rock, in which the veins at *Shemnitz* and *Kremnitz* are running. They unite with the *Carpathian* mountains.

In the valleys behind *Shemnitz*, near the glass manufactory, and in several other places of the *Lower Hungarian* mines, hills of grey limestone are accumulated on the sloping, nay even on the summits of this argillaceous rock.

The metallic rock near *Shemnitz* contains three capital veins, parallel in their run with the direction of the river *Gran*, nay even with the bendings of its channel, as clearly appears by the mineralogical map of the *Shemnitz* veins, which has been published by Mr. *Zipser*.

The largest is the *Spitaler* vein. It runs from north to south between twelve and four, and dips from west to east from thirty to seventy degrees. In the remotest northern field this vein,



belonging to the *Nicolai* mine, was crossed by a drift, and found deaf in the depth. Here it consists of grey loose and soft clay, mixed with spar. But the old rubbish seems to indicate that there were likewise rich and metallic veins in the upper level towards the day. Somewhat more to the south, in the fields of *Michels* and *Packer-Stolln*, it furnishes good stamp-ores. Here the vein consists of quartz, leadglance, and zinnopel; and the washed metallic powder contains a good deal of gold. In the field of the *Packer Stolln* it is larger than any where else. On the twentieth drift or parallel for example, at a depth of 127 fathoms from the *Elizabeth* shaft, it is fourteen fathoms wide, and the deaf rocks included eighteen. This remarkable thickness of the vein has caused the cross-works to be introduced. The company of the *Three Kings* and *Packerstolln* has here in the depth of the thirteenth level or drift, that is to say, in the depth of eighty-seven fathoms very rich ores, which in a greater depth change in zinnopel stamp-ores.

Further to the south, near the limits of the *Windschaft* field, an argillaceous white vein unites, and thence constantly runs with it in the hanging. The vein is from that place found to contain silver. The white clay of this hanging fissure offers now and then nodules of spar and quartz pieces.

Containing

Containing four or five ounces of silver per hundred weight; they are carefully gathered. At last the form of the vein is entirely altered in the *royal wind-shafts* field; and it consists of broken quartz, which, if mixed with spar, yields richer ores of dissolved pyrites and of an irony ocher, which seems to contribute to its increasing auriferous quality.

This irony ocher decreases in the same proportion as the vein is advancing to the south. The remotest field to the south, distant from the northern about 3000 fathoms, is entirely deaf.

The *Johns* vein runs in a distance of 1000 fathoms in the hanging of the main *Spitaler* vein. According to Mr. *Zipser's* map, this vein seems to be the same which I mentioned before, as uniting or issuing from the chief vein. The vein-rocks or substance of this fissure is white clay, containing sometimes ore, sometimes metallic quartz, and sometimes sprinkled metal flakes. In its midst occur now and then separated and deaf zinnopel fragments, or dissolved zinnopel. To the south, on the fourth and fifth drift or level, its substance turns harder and richer; however, it has constantly in the hanging an argillaceous skirt or separation of two or three inches thick, and in the hanging a skirt of zinnopel about one foot thickness.



The mines working on the *Spitaler* vein are: the *Windschaft*, *Packer-Stolln*, *Three Kings-Stolln*, the *Glanzenburg*, *Michels-Stolln*, and the remotest northern *Dillner* deep gallery-works. I am to take notice here of a singular curiosity, which is that in a drift driven on this vein, and in a perpendicular depth of eighty-nine fathoms from the *Elizabeth* shaft, I have found included in the found zinnopel a species of petrified porpites. \* I am possessed of a fragment of zinnopel with several impressions of this marine body, and a porpites belonging to one of these impressions; both offered to me in a bing-place of the *Spitaler* vein, among the rubbish and stamp-ores, which then were carried out. The day after I went myself into the mine, asking the workmen and officers whether this sort of impressions and stones had offered to them in working out stamp-ores? They answered me in the affirmative, but unconcerned at their singularity had constantly rejected them under the stamp-ores. However, my endeavours to find some other specimens for my mineralogical friends have been to no purpose.

\* It is properly a petrified *Madrepora simplex*, *subtus plana*, *annulis concentricis*, *supra convexa*, *umbilico impresso*, *lamellis approximatis* in *superficie granulosis*. The same species, tho' hitherto undescribed, is common near the salt-works at *Gemunden* in *Upper-Austria*.

Now,

Now, my dearest friend, tell me how these petrifications may have been brought into a vein of a mountain, which cannot be ranked among the accidental mountains, and whose very rocks prove it to be of the primitive or original kind. If there were any higher superincumbent calcareous hills, this phenomenon might prove less singular. But our calcareous hills are on the sloping of the mountain towards the glass manufactories, and these petrifications cannot possibly be carried thence to this high elevation, as none of that kind are to be found in the calcareous and lower strata. However, a single circumstance seems to give some explication. You remember a hill to the north of *Shemnitz*, which of late is decorated as mount *Calvaria*. It consists of micaceous clay shistus, mixed with detached pieces of red jasper, which greatly resembles the dead zinnopel. Petrified turbinites and chamites have been very often found about this hill; and samples of these petrifications are in my cabinet. Might not, when this accidental hill was produced, and the whole country was still under seawater, some of these crustaceous animals have been carried by water in the still gaping fissure of this large vein? and by that accident have been brought into the mass of zinnopel? § The detached jasper pieces

§ If these petrifications were of the same kind as those in the before-mentioned hill, which is not, or the species of turbinites



pieces, mentioned before, seem to have been brought by similar accidents in the *Johns'* fissure in the hanging of the vein.

The second or the *Beaver Stollner* capital vein runs in a distance of 100 and 150 fathoms, in the hanging of the *Spitaler* vein, parallel with it both in its run and in its dipping. The vein-rock is quartz mixed with pale yellow and reddish spar, zinnopel, and richer ores. In the hanging towards the *Spitaler* vein it contains zinnopel and lead stamp-ores; but in the hanging is a skirt of clay, from one to four foot thick, with nodules of lead-ore, which yields from two to five ounces of silver. This vein has not been worked, nor found metallic so far to the north as the *Spitaler* vein. Near the *Amelia* shaft the *Daniel* fissure, straying from the *Theresia* vein, unites with the *Beaver Stollner* vein, and makes it richer. More to the south in the *Christina* field this vein has undoubtedly yielded the greater quantity of ore. Hereabout several regular and irregular fissures, such as the *Althandle-*

turbinites and chamites, which are common in that hill, were likewise so in the zinnopel vein, which Baron *Born* would certainly have taken notice of, then the slate-hill and vein-rock of the *Spitaler* vein might be considered as produced in the same time. However, the vein rock may have been produced by similar circumstances, but in times anterior to the origin of that slate-hill. (Transl.)

*Rosbka,*

*Rosbka*, and some other hanging and hading ones, sometimes unite and sometimes separate from it; especially the *Wolf-gang* vein parts from it and runs towards the *Spitaler* vein. An hundred fathoms more to the south, in the *Siegelsberger* field, this vein has its greatest width, which is from four to five fathoms. However, it is crossed by two small fissures. They worked the first by galleries, and found on the ninth drift a vertical vein, till then unknown, which has ever since yielded the richest ores. The three hanging fissures, straying from and running parallel with the main vein, yield likewise great quantities of rich ore. Beyond the *Konigsegger* shaft to the south the vein is dead at present. But the southern part of the mountain is reserved for the chamber, in order to examine the vein and to lengthen the works.

The *Theresia* vein runs in a distance of 150 fathoms further in the hading, in a direction parallel to that of the two before described. On the highest part of the mountain it bassets out, and is less examined than any other. To the north it dips from east to west, that is to say, in a contrary and irregular direction; more to the south it turns perpendicular; and further beyond the *Theresia* shaft it dips parallel to the other capital veins at *Schemniz*, that is to say, from west  
to



to east. The vein-rock is lead-ore, mixed with zinnopel; however, in some fissures, especially *S. Daniel*, it has yielded richer ores. Its soundness is the cause that the works on this vein are not sunk above 150 fathoms, that is to say, to the sole of the *Trinity* gallery. The zinnopel veins being richer of gold make amends for their being poor of silver. That is the case in this and the *Spitaler* vein. On the eleventh level, that is, in a depth of 116 fathoms, they have found in the midst of the sound mountain rock, when cutting a cross door, or an oblique drift, a great number of bullets from one to two inches thick, consisting likewise of metallic rock, and being either loose or sticking to the other rocks. I am at a loss to guess how these globular stones came into the mountain, or why they came to be produced in this form rather than in that of the other compressed rocks. On the *Klingerstolln*, belonging to the *Theresia* shafts field, I observed the remains and marks of old works, done before the invention of gun-powder, which the ancients called *pocket works* (*taschen arbeit*) and produced by strong and dry wood wedges, forced in the hanging side of the doors or galleries. These wedges being wetted afterwards broke the rock by an effect of their expansion.

I remember that in the description of the *Spi-taler* vein I mentioned deaf wedges, which frequently offer in the greater veins at *Shemnitz*. They consist of an argillaceous grey rock, differing from the metallic rock in a single circumstance, that instead of mica it contains spots of white lithomarga.

The width and thickness of these veins has probably occasioned the great quantity of crystallisations which are so common in these mines. Being filled with metalliferous substances there might have remained, or by their drying have been produced those holes in which the crystallisations are deposited. They are generally filled, or at least incrustated within by calcareous, felenitical, or quartz crystallisations. Supposing that their regular forms are owing to salts, as commonly is supposed, the variety of metals and semi-metals of the large veins at *Shemnitz* seems to have naturally produced that great variety of fine crystallisations which you have seen in my cabinet.

Thus I have communicated to you my observations on the chief veins at *Shemnitz*. However, I add that they are worked with success to the greatest depth, since the auriferous zinnopel continues in vast quantities. Though this depth be about 200 fathoms, it is of no great importance in respect to the inner structure of the globe, if  
we



we consider that, according, to Mr. *Podas* barometrical observations, made under ground, the seventh sole in *Sargozsi* mine being 158 fathoms below the *Charles* shaft, and 286 fathoms below the *Theresia* shaft, is still much above the level of the city of *Vienna*. Accordingly our subterraneous geographers have no reason to be proud of their discoveries of the inner structure of the earth; even our deepest shafts have at most but scratched its exterior surface, and *Ovid's*

*Itum est in viscera terræ* will be a poetical extravagance, till *Maupertuis's* unphilosophical proposal of a shaft sunk through the centre of the earth to the *Antipodes* be brought into execution

All the royal mines at *Shemniz* are drained and underworked by the Emperor *Franciscus's* gallery. Its door or entrance is five *English* miles from *Shemniz*, in the *Hodrizer* ground. It was begun in 1748, and happily finished in 1765. Continually driven in sound and hard metallic rock, and in a considerable height and width, it is to be wondered at even by connoisseurs how this immense and difficult work could be achieved in so short a time. It is lengthened still further.

The private mines, working in other metallic veins, and belonging to the metallic court at

*Shemniz,*

*Shemniz*, are to the west or to the north in the *Rofs ground* near *Eisenbach*, or to the south in the *Hodriz*. The *New Hope-Stolln*, the *Hofer Erb-Stolln*, *Windshleuten*, and the *Old Antony de Padua Stolln*, are the most considerable mines in the *Rofs ground*.

The mountains consist here generally of metallic rock; the veins, like those at *Shemniz*, running from north to south.

In the southern valley is *Old All Saints Stolln*, a royal mine, which in former times yielded very rich ores, whose remains are still working. The co-incidence of some large veins has produced here vast caverns, supported by the sparings of deaf rocks. Here I found in a pit the year 777 cut in the rock. Might I hence draw a consequence for the high antiquity of this mine? The rocks are here likewise our argillaceous grey rock, with this difference however, that it is as in all the other *Hodriz* mines mixed *Lithomarga*.

Next to this mine follows *Finstert Ort* and *Brenner-Stolln*, whose vein-rock consists of large auriferous and lamellated quartz, extremely light, very often as it were cut with a knife, but commonly in a state of corrosion, and containing in its holes rich auriferous red and brittle glass silver ore. The *New Antoni de Padua Stolln* has a similar quartz vein.

More



More to the west our metallic rock is covered with argillaceous slate, crossed by iron and lead-veins. The same appears in the *Rofs ground* valley, where the slate begins near the *Eisenbach* bath, and yields iron-ore, and now and then some fine load-stones.

I pass silent over many smaller private mines to speak now of *Belo-Banya* or *Dulln*, a mining place to the north of *Shemniz*. The mountains the same as at *Shemniz*, but an hour's way distant. The mines do not seem to have been of great importance in former times; and nothing is left but the names of some mines and the still working deeper *Dullner Erb Stolln*. The *Dullner Nicolai* shaft is sunk on the *Spitaler* vein, and belongs for the greater part to the royal chamber. I saw here on the *Seven Women* vein, in the northern field drift, several old blasting-holes, one marked with the year 1637. *Rofsler* § relates, that in 1627 the blasting of the mines was brought from *Hungary* and introduced in the *German* mines. But *Bayer* says, that in 1613 it was invented by *Martin Freygold* at *Freiberg*, an assertion which is repeated of late in the account of mines and their workings, published by the miner-academy at *Freiberg*.

The *Maria Hulf* company works on a vein of auriferous pyrites. It runs from north to south.

To the south, on the other side of the *Reich-awer* water-reservoir, is a private mine, called the *Moderstolln*, on a vein of auriferous quartz. It has given good dividends.

Further to the south is *Baka-Banya* or *Bugganz*, a mining town. The mountains, like those at *Skemnitz*; some veins running to the east. Sundry companies have of late taken up different old mines, in auriferous quartz and spar veins. The *Ladislai* company produces already a good deal of gold, which often appears in a granulated form.

Behind *Bugganz* the sloping of the mountain is argillaceous slate, dipping under the plain which by *Tyrnaw* continues to *Presburg*. On the northern side of *Presburg* appear the roots of the *Carpathian* mountains, which near *Modern* are working for lead veins, mixed with asbest and running in horn-slate.

I have noticed already in my last letter the *Schistous* mountains to the east of *Skemnitz*. To the north, on the sloping of the mountains, are calcareous hills of white fine-grained limestone. They extend to the *Glass-buttner* bath, which consists of a hot well, used for many infirmities. The water  
O deposits



deposits tophus mixed with iron ocher, and the canals in which it is conveyed to the bathing-house are incrustated by it. Many tophaceous hills of the same kind are seen hereabout, and probably have been accumulated on the surface before the water was collected into canals.

Between *Creuz* and *Lebotka* is a fine cultivated plain. Marks of coals have been found here, and mentioned already by *P. Kircher* in his *Mundus Subterraneus*. Near *Lebotka* and the highway I found white shivery hornstone, petrofilex, resembling chalcedony and containing some petrifications of plants or corals. Probably these detached loose stones have been carried hither from *Leskowiz*, beyond *Cremniz*. A rivulet, which flows here, comes that way; and found beds of such milk-white hornstone are found near that place, besides a great number of detached jaspers and achates, which are very common in the fields thereabout, and near *Deutsch-Littaw*.

The mountains at *Kremniz* are our common metallic-rock. The works are on a large and rich gold-vein and on some of its ramifications. The rock is white solid quartz, mixed with fine auriferous red and white silver-ore, and with auriferous pyrites. This pyrites, properly stampd and washed, contains from two to three drachms of gold per hundred. The vein runs from south to north, and is auriferous above a length of 3000 fathoms

fathoms. It has been searched already to a depth of 150 fathoms, and is constantly found auriferous.

The same vein is, besides the royal mines, worked by the *Rothsch* company and the citizens at *Kremniz*. Fine striated grey antimony found in the king's shaft. The whole vein being metallic, a great number of stamp and wash-mills are established here, and to great advantage directed by your countryman Baron *Watram*.

Further to the north, near *Tshavoja*, some lead-veins are working in blue micaceous clayish slate, probably superincumbent on metallic rock.

To the east *Kremniz* is separated from *Newsol* by a steep mountain, consisting of metallic rock and covered with slate. At its top, called the *Skalka*, red native sulphur has been found in a grey superincumbent sand-bed. On the other side of the hill is *Tajova*, known by the royal copper- and parting-furnaces. Near this place crystalline orpiment, *Auripigmentum crystallisatum*, *crystallis polyedris*, is dug from a blue clay vein in slate. The hills thence to *Newsol*, an hour's way distant, are calcareous.

This city is in a pleasant plain on the *Gran*.

To the north, near the village *Jacub*, rises the mountain *Baran*, consisting of argillaceous slate, accumulated on limestone and containing some copper-fissures. Nearer to *Herrn Grund* ap-



pears again the grey micaceous clay shistus, in which the mines are working. There are three chief veins, running from north to south, and dipping from forty to fifty degrees from east to west. The vein in the hanging is called the *Copper-vein*; the second to the hanging the *Herrngrunder-vein*; and the third, more in the hanging, goes under the name of the *Pipe-Stolln-vein*; to which may be added a fourth, further in the hanging, and called the *Rat-ground-vein*. All these veins are cut off to the south by an oblique crossing vein of red irony argillaceous slate, which is many fathoms thick. Beyond this red vein they have begun a gallery, unsuccessfully driven already 278 fathoms length in black limestone, in hopes to reach again the copper-veins, if they should be found continuing on the other side of this red vein. The vein is common shivery clay, different from the mountain by a small mixture of mica. Often the ore is sticking to quartz and gypsum. The ore commonly copper-pyrites, called here *gilsf-ore*, containing no silver, but from eight to ten pounds of copper in a hundred. There is likewise grey copper pyrites, containing sixteen or seventeen pounds of copper, and from three to ten ounces of silver. Accidentally they meet sometimes with fine samples of white ore, *Cronstedt*. §. 199, crystalline grey copper-glass, *Cuprum vitratum crystallisatum crystallis decæ-*  
*dris*

*dris* & *planis tetraëdris*, noble samples of verdegrease and copper azur, malachites, and white hair or capillaire vitriol, *Halotrichum Scopoli*, sweating from or sticking to the sides of the works. This vitriol, which in undeterminate blue and green crystals is likewise produced on the timber, contributes greatly to its preservation, since times immemorial no repair of timber has been wanting. The copper-ores at *Herrngrund* are auriferous. For this reason they separate the gold-dust in the wash-mills. It would be impossible to separate it to advantage by smelting and parting. The whole mine is divided into six fields, three to the south and three to the north. In the northern fields the *Kugler*, the *Pipe-Stolln*, and part of the *Herrngrund* veins are working; in the southern they work only on the *Herrngrunder* vein. This vein is twelve fathoms wide. However, the different direction of the rocks, which it crosses, affect it sensibly, either interrupting its run or forcing it into an other line of the compass. The same happens to the other veins. It has been constantly working these last five hundred years to a depth of 150 fathoms. The *Pipe-Stollner* vein is some fathoms thick; but the *Kugler* vein is only four feet. The cementing water is conducted by sloping wood-canals, and many angulated windings in large wood reservoirs. In the corners of these canals, and in the reservoirs, they put old



iron, which precipitates the copper so successfully, that the sediments contain near seventy pounds of copper per hundred. The annual produce of this cementation does not however amount to above 5000 pounds. There is another profitable establishment in the *Herrngrund* copper-works, a manufactory of verdegrease or mountain-green, *Viride montanum nativum*. To this purpose the mine-waters are conducted on old bing-places, which impregnate them with vitriol by the solution of the copper flakes sprinkled in the deaf rocks. Thence they are led in several wood reservoirs, where running against obliquely erected planks the green precipitates as a sediment. An hundred weight of this green sells for 100 florins, and is to that rate delivered to the mineral ware-and sale-house at *Vienna*.

The negligence of the ancients in separating the ores has likewise in this place caused many bing-washings. Tho' there is a great number of them, they do not produce annually but about 300,000 pounds of clear copper.

Travelling from this place to *Moditska* towards *Liptaw*, you see on both sides of the way a chain of calcareous stalactite-like hills, above thirty fathoms high. Probably this stalactite has been carried hither by rain-water, from the limestone, superincumbent on the *Carpathian* mountains.

I am

I am however at a loss how to explain the figure of this crystalline limestone, which exactly resembles that of stalactites, and appears often in globular and columnar forms of one or two feet thick.

Beyond *Moditska* is a lead vein in limestone, worked without success.

The iron works near *Rhoniz* and *Thaisolz* belong likewise to the chamber at *Newsol*. At *Rhoniz* the iron-veins run in slate. The richest is on the *Sirk*, and produces some iron spar. I have not seen *Thaisolz*. The hills about *Newsol* are calcareous and superincumbent on argillaceous slate. But nearer to *Shemniz* the common rock is again metallic rock.

On the midst of the way to *Shemniz*, where the highway to *Kremniz* and *Newsol* separates, I observed near the bridge over the *Gran* some rocks of breccia, consisting of argillaceous and micaceous blunted stones, and reddish granite pebbles ferruminated by lime. Probably they have been carried hither from the *Carpathian* mountains and deposited by the river in the before-mentioned rocks.

Near *Poinik*, an iron work under the chamber of *Newsol*, the iron vein runs in slate, and produces these fine iron ores, incrustated with blueish distilled chalcedony, which you have taken notice of when you were in *Hungary*.



*Königsberg (Ui-Banya)* in the *Borsber* district, is in rank the seventh of the free *Hungarian* mining towns. It is some miles to the north-west from *Shemnitz*. The valley wherein it is situated consists on one side towards *Shemnitz* of metallic-rock, and on the other to the north of granite-hills, running hither from the *Carpathian* mountains. In the royal mine, at present working again, the vein runs between the red granite its hading, and between the metallic rock its hanging side. They call this granite mill-stone; since its feld-spath particles being dissolved, and having left many holes, make it a good mill-stone. To this purpose it is exported to many parts of *Hungary*. The vein is grey quartz, mixed with auriferous pyrites. This place is remarkable on account of the first steam or fire-engine established in the *Lower-Hungarian* mines, built here 1721 by *Isaac Porter*, an *English* engineer in the imperial service. Its object was the draining of the *Altbandler* shaft; but, the works being given up nine years after, the engine has disappeared of course.

These are the notices which I have been able to take in respect of the *Lower Hungarian* mountains, veins and mines. If I should recover my health next summer, I intend, in Mr. *Poda's* and *Scopoli's* company, to make a trip in the *Carpathian* mountains; *Scopoli* to gather plants  
and

and insects ; *Pöda* to make physical and mathematical experiments ; and I for my part to have an eye to the nature of the mountains and the fossils.

The descriptions of the metallic-mountains in the district of *Liptaw*, given by *Bel*, in his *Notitia Hungariæ*, and several curiosities which some students have brought me from the *Carpathian* mountains, prove to conviction that such an excursion will be an advantage for Natural History. Were this part of science better cultivated in *Hungary*, this kingdom might, I am confident, furnish more remarkable observations, than perhaps any other in the World. But, alas ! scarce the name of that science is known hereabout, and I fear we may for a long while repeat with old *Seneca* to the lazy *Hungarians* : “ *Sicut barbari plerumque inclusi & ignari machinarum segnes labores obsidentium spectant, nec quo illa pertineant, qua ex longinquo struuntur, intelligunt, idem vobis evenit. Marcetis in rebus vestris, neccogitatis !* ”

LETTER



## L E T T E R. XXI.

Skemnitz, Sept. 13, 1770

YOU have seen by the series of letters, which hitherto I have written to you, that the mountains in the *Bannat*, *Hungary* and *Transsylvania* consist of granites, clay, lime, horn-and sandstone. But which are the most ancient? which are the richest? which in each of them is the rule of the veins and fissures? how have the different rocks succeeded each other? These queries properly answered might furnish a compleat theory of the *Hungarian* mountains.

The most ancient mountains in *Hungary* and its dependencies can only be observed in the highest mountains; and even there care is to be taken against the illusion of the superincumbent outside. The *Carpathian* mountains, for example, might be considered at first sight as calcareous mountains, if examined only in such places where mines are working in slate and limestone; but that would prove as wrong as if a man was to fancy that hills covered with vegetable mould are thoroughly composed of it. Examining with this caution the *Carpathian* hills as far as the *Marmaros*, and those which separate the *Moldaw* from *Transsylvania*,

*vania*, and rise near *Wershez* in the Bannat, we constantly find that their undermost strata, or rather their main-bulk and nucleus, consists of granite.

I had ordered a young man, used to gather fossils in the *Carpathian* mountains, to observe every rock appearing above the superincumbent mountains, and to bring me samples from those rocks as well as from the highest *Carpathian* summits. I had them, and it was grey granites. You remember the granite-chain running towards *Königsberg*, which I mentioned in my last. I observed there, that the granites is in the hanging, and argillaceous rock in the hanging side. Hence it appears that the argillaceous rock is accumulated and superincumbent on the granites.

The granite rocks in the mountains behind *Alt-Sol*, running to *Upper-Hungary*, the same rocks which I mentioned at *Felső-banya* and *Kapnik*, and run there underneath several superincumbent strata to the *Carpathian* mountains, prove to conviction that they consist of granite. Look over my letters again from the Bannat. You will find noticed several places, in which the granite appears peeping from under the slate and limestone. Mr. *Delius*, in his Treatise on the Mountains, has likewise mentioned some such rock; and these are granites, which includes the *Hazeg* valley, and separates the *Moldow* from *Transsylvania*. It appears there either entirely naked, or covered with a slate  
or



or limestone roof. All these facts together are fair evidence of the higher *Hungarian* hills consisting of granites. It is material to add, that there is no place in *Hungary* in which the granite appears to be naturally incumbent on other rocks; that wherever it appears above ground, the superincumbent more modern stone strata are easily to be distinguished; and that granites has never been found in any mine to alternate stratified with other rocks. I know by the mineral-history of other countries that the same has been observed in general. However, I would not be understood as did I suppose the inner part of the globe to consist of granite. It is rather probable that granite in such depths, which hitherto we have not reached, and perhaps never shall, are accumulated on rocks of a simpler mixture. Nevertheless granite is the most ancient rock hitherto observed; and that opinion is greatly confirmed in *Hungary*.

To my knowledge there have not been hitherto found any metallic veins in the *Hungarian* granite-mountains. The *Altbandler* vein at *Konigsberg* runs in the separation between the granites and the metallic-rock. Perhaps after-times will lay open these hidden treasures. That veins are running in other countries through the granite is a fact too obvious to want here to be evidenced by me.

The

The second species of rock, which seems to have been produced after the granites is argillaceous, such as hornslate or argillaceous mica, thoroughly mixed with quartz. 2. *Kneifs*, consisting of quartz, mica and lithomarga. 3. The metallic rock, being a hardened clay, mixed either with quartz or spherul and spar or lithomarga. And lastly, 4. trap and shivery clay.

Hornslate is to my knowledge very scarce in *Hungary*; but you have seen by my letters, that the lead-veins near *Modern* in the county of *Presburg*, on the foot of the *Carpathian* mountains, run in hornslate: and at *Ruskowa* in another lead-vein, under the chamber of *Shemniz*, likewise on the foot of the *Carpathian* mountains, the common rock is of the same kind: But these veins are leaping, thin and inconsiderable.

*Kneifs* is on the sole of *Simon Judas*, at *Dognazka* in the Bannat. Between *Saska* and *Moldova* whole mountains consist of it, but unobserved to contain any copper-vein; and near *Shemniz* the *Kaiserstolln* in *Hodrix* is driven in *Kneifs* for an auriferous quartz vein.

The most common and the most remarkable of these argillaceous rocks in *Hungary* is the metallic rock, which I have described before. Near *Königsberg* we have found it immediately incumbent on granites. The large and constant gold and  
silver



veins at *Skemnitz* and *Kremnitz*, as likewise the many rich veins at *Felfo-Banya*, *Kapnik*, *Nagy-Banya*, *Nagyag*, *Fufes*, *Boitza* run in it. In the Bannat the constant copper-veins, nay even the richest mine at *Dognazka* are found in the same rock.

Our *trap*, which I have seen only in a single mountain at *Kapnik*, contains but small veins.

The *argillaceous slate* is the common rock at *Schmolnitz*, *Newsohl*, *Tshavoja* behind *Kremnitz*, in the Bannat, and in the salt-works at *Torda*, *Marmaros* and *Sovar*. It contains commonly short, thin and leaping copper-veins, running either across or along this rock under incumbent limestone.

*Limestone* is the third, and if we do not take notice of the accidental beds, the most modern species of rock. In the Bannat it is constantly accumulated or deposited on clay. In the *Oravitza* mountains some pretty constant copper-veins, and at *Saska* and *Moldova* some short copper-veins are working in it. In *Transsylvania* behind *Nagyag*, from *Darscha* to *Glut*, I found calcareous hills incumbent on argillaceous rocks, in which some poor copper-veins bassetting out to the day were working. I do not remember to have heard of any metallic veins in the many high calcareous hills, which are superincumbent on the granite-hills

hills in the *Carpath* or those which separate the *Moldaw* from *Transsylvania*. From all these facts it follows, that veins between slate and limestone have constantly a hanging of slate and a hanging side of limestone. I am really of this opinion, though I have had many objections against it, when in the Bannat I found some mines with a hanging of slate and a hanging of limestone; but on nearer examination these my scruples disappeared for very good reasons, which I will speak of in the description of the accidental rocks. Here I am obliged to take notice, that lime is very often immediately incumbent on granite. Thus I have been told, at least by many people who have seen the *Carpathian* hills, and may be very well accounted for by supposing granite rocks uncovered by argillaceous rocks when the limestone beds were produced.

Thus far of the three ancient species of rocks, known in *Hungary*. Though it be impossible to determine whether they have been produced within a short space of time, or whether they have been accumulated in a long succession of many ages, I am rather inclined to the first opinion. I have seen granite, whose surface, where it was in immediate contact with the incumbent clay, was entirely changed into clay; nay I keep in my cabinet some pieces of granite, with inclosed fragments



fragments of slate. I have seen argillaceous mountains, and noticed them in my letters from the Bannat, which by the superincumbent lime were penetrated and changed into marle. Might not these facts incline us to believe, that the granite and clay-beds were still in a state of a wet paste, when the superior beds were accumulated and deposited upon them? and that accordingly the origin of these different rocks cannot be greatly distant in respect to time? But I go astray in hypotheses which in this place are to no purpose. It is a great satisfaction to me, that my observations on the origin of the rocks agree with those of the best naturalists. Being established on experiments and facts, which I have seen myself, I am under no apprehension, that my system can possibly be considered as an adopted opinion, or what is still worse, as a fancy hatched in my study. Baron *Haller* has given in the preface to his Description of the *Helvetia*, a fine account of the *Alps* in *Switzerland*. He is very explicit that the highest tops of the *Alps* consist of a rock, which is composed of glimmer, quartz and a looser stuff, probably feldspath, is of a granite-species, and goes in *Switzerland* under the name of *Giesbergerstein*. The common *Alpine* rocks are a species of slate; and the lower hills are covered with limestone, some sorts of marble,

marble, and other hard rocks. The same is confirmed by Mr. *Gruner*, in his account of the ice-mountains of *Switzerland*. Lord *Bute* has noticed the same rule in the *Pyrenean* mountains, and communicated that observation to Baron *Haller*. The *Tyrolian* mountains are granite covered with slate, as I see by a collection of fossils, which Baron *Adolph Meyer* has brought me from that country. The same is observed in the *Bohemian* mountains. When I lived at my country seat *Altzedlitz*, on the high mountains which separate *Bohemia* from the *Upper Palatinate*, I examined these hills with attention. The whole chain of mountains, which from *Bavaria* runs to the circle of *Eger*, is granite, in several places covered by hornslate and other argillaceous rocks. Near *Eger* and *Mautdorf*, towards the *Palatinate*, on the sloping of these mountains the first limestone-hills occur to the observer. Baron *Pabst von Ohain* at *Freyberg*, and Messrs *Charpentier* and *Lommer*, professors in the miner-academy at *Freyberg*, have made several excursions and observations to the same purpose in the *Harz* and *Saxonian* mountains; and the *Swedish* are of the same nature according to your observations and those of Baron *Linneus*. It is to be hoped that naturalists, skilled in mineralogy, will henceforth examine this opinion wherever they should happen



to have an opportunity to do it ; in order to bring it to systematical evidence, as highly interesting to philosophers and miners.

But let us return to the *Hungarian* mountains, and examine their accidental rocks. Such are in my opinion some limestone hills, the sandstones and some slate-strata.

It is a hard task to determine, which limestone is more ancient, and which accidental. The greatest mineralogists ascribe the origin of limestone to a destruction of marine shell-fishes. But is it possible that those immense masses of limestone should be owing to the animal kingdom ? A great part of the *Carpathian* mountains, the bordering hills of the *Moldaw* and *Transsylvania*, the mountains in *Steyermärck*, and a great many more to my knowledge are almost entirely covered and buried under limestone. What immense quantities of shells would not be requisite to the origin of these limestone-hills ? *Cronstedt* has observed already, that the granulated and scaly limestone is destitute of petrifications. Are we by that intitled to rank these species under the ancient calcareous rocks, and those with petrifications to the accidental ones, produced by more modern inundations ? I shall leave that entirely to the determination of those learned men, who have more principles and observations than I have acquired

quired myself. But it is fact, that in *Hungary* hitherto no metallic veins have been discovered in rocks filled with petrifications. I rank however the stalactite-like limestone beyond *Altgeburg* and *Newsohl* under the accidental limestone. In the same class I rank the sandstone, which in *Hungary* surrounds the nobler metallic mountains, as near *Nagyag* and *Facebay* in *Transsylvania*. Sometimes they appear in insulated hills; and often they are accumulated on calcareous ground. In these sandrocks there has not been hitherto found any constant or metallic vein. The *accidental* slate is often accumulated on this sandstone, on lime and other ground. It is produced as the stalactite-like limestone by rain or other water, which washed and carried together the dissolved particles of the more ancient mountains. Thus it covers, for example, the coal-beds between *Kremniz* and *Shemniz*, near *Roniz* and near *Waizen*. By the same reason it appears as the hanging side in some mines of the Bannat of *Temeswar*. I saw at *Saska* a mine whose hanging was limestone, and whose hanging was slate. The copper-vein was in the limestone. The old hanging side, if there was any before, seems to have been carried away by accident; and then the dissolved parts of the higher argillaceous hills, which I mentioned in my journey from *Saska* to *Moldova*, have been



carried there and composed the present hanging. The red slate at *Nagyag*, near *Boicza*, and near *Zalatbna* in *Transsylvania*, seems to have had a similar origin.

As indurated clay is not so easily dissolved by water as limestone, this slate never occurs in large beds or in considerable hills. The mixture of dissolved limestone and argillaceous parts has probably produced the marle, which in respect to its œconomical uses is entirely neglected in *Hungary*.

It is certainly matter of surprize to you, that hitherto I have not mentioned the hornstone: *Petrofalex*: But I freely confess I am at a loss where to rank it, whether among the old or the accidental rocks. In my letter from *Zalatbna* I described the mountains at *Facebay*, especially the *Loretto*-mine. This rich gold-mine is working in hornstone, incumbent on argillaceous beds; but it clearly appears to be produced by modern inundations, as you will remember from the letter to which I referr you. The petrifications in the white hornstone near *Lebotka* prove that this species of rock belongs to the accidental ones. I cannot consider the horn and flint-stones as produced by the gelatinous substance of marine insects; a fancy which once a good naturalist has in confidence entrusted me with, but I rank it

next

next to the current hypothesis, of limestone being the remaining substance of destroyed and dissolved sea-shells.

The veins in these hornstone-mountains are more constant and richer than those between argillaceous slate and limestone. Those at least, which I described to you in my letters, contain gold and silver-ore. If this rock should belong to the more ancient ones, which I leave to your determination, it must have been produced at the same time as the calcareous strata were produced, since I find it never incumbent on lime but constantly on clay. Perhaps future observations will prove some species of hornstone, like some species of clay, slate and lime belong either to the ancient or to the accidental rocks.

All these primogenial and accidental mountains and rocks owe their origin to water; and have been produced, either when the world was raised from the chaos, or according to Mr. *Linneus's* opinion, when the whole earth was covered with water, and the precipitation, crystallisation and dissolution of so many animal and vegetable substances brought forth so many new stratifications; or finally they arose from later inundations.

I should here mention those mountains that are produced by fire. There are actually some marks of such mountains in *Hungary*. The vitre-



ous black lava, *pumex vitreus Linnæi*, at Tokay in Hungary, and several sorts of lavas from the Carpathian mountains, give conjectures and evidences of that kind. But to be particular on that account, I want to examine the whole chain of the Carpathian hills, which I have a mind to do next year if my impaired health puts no stop to these my intentions.

LETTER

## L E T T E R XXII.

*Skemnitz, Sept. 28, 1770.*

BY the last post I received an order from the court, to accept of the vacant commission of Count *Colloredo* in the board of mines at *Prague*. I do not know whether I shall rejoice at it or not. It is out of my power to visit the *Carpathian* mountains; however I am to follow where destiny calls me to no unprofitable situation, and I am preparing for my journey to *Prague*. Though I have but a few moments to spare, I give, according to your desire, an account of the different ores found in the *Lower Hungarian* mines.

Native gold is very scarce in the royal mines at *Skemnitz*, though in general the ores are auriferous, being for that very reason pulverised and washed. In the beginning however of January last, they have found in *Emperor Francisci Stoln*, in the field of *Siegelsberg*, and in a soaring fissure, which runs towards the great *Bieberstollner* vein, a lump of found red silver ore, mixed with glass ore, and



covered with some native gold. A hundred weight of this ore contained about 1270 ounces of silver. In the private mines the native gold is more obvious ; it appears in a capillary form on quartz, in soft and brittle glass ore on the *Hofer* and *Antony de Padua* mine. So it is found likewise on red silver ore. At *Kremniz* and *Konigsberg* it is still more common. At *Kremniz* it is often found in lamellæ. I have likewise a fragment of iron quartz with native gold from *Ladislai-Stolln* at *Bugganz*. The *Lower Hungarian* gold is in general to be cleared from auriferous wash-ores or from zinnopel, which is a mixed red jasper, containing gold, silver, lead, zinc, and pyrites. It is the common rock of the *spital* vein, and in general strikes fire with steel, though there are some looser species of this zinnopel, which taint the fingers and look like red bole. Perhaps its constituent parts will prove it to be of the bolus kind ; the looser species appears often in a globular scaly form like button ore striking on harder zinnopel : If found stratified in wash-ores, consisting of blende, lead, and a blueish clay, it goes under the name of *string zinnopel*, (*schnur zinnopel*). Mr. *Scopoli* is at present about a laborious chemical analysis of the zinnopel,

zinnopel, which he intends to publish in his *Anni historico-naturales*.

I can form no idea of the yellow zinnopel, mentioned by Mr. *Cronstedt*, unless he means to give that name to irony jasper. If that should be the case, we might as well give the same denomination to the red jasper, which is so common in the *Calvariberg* and the *Packerstolner* vein where it is rejected as rubbish. The denomination of zinnopel implies an auriferous quality.

Another species of auriferous stamp or wash-ores is the irony quartz found at *Bugganz*, and in the *Kaiserstoln* at *Hodriz*. You remember perhaps a passage in the account of mining works published at *Freiberg*, in which is conjectured, that irony quartz is generally auriferous; our stamp ores seem to confirm it.

The pyrites, separated from the lead and blende by pounding and washing, contains likewise a great deal of gold. A hundred weight of this pyrites yields fifty-four pounds of stone or lech, and three denarii of silver, which per mark contains fifty denarii of gold. The pyrites at *Konigsberg* and *Kremniz* are still richer. Pyrites containing silver, go here under the name of *Gelft*.

Native silver is still more uncommon in the *Lower Hungarian* mines; all the while I have been here I have got but two samples, one from *Old Anthony*



*Anthony de Padua Stohn* and the other from *Theresia-Shaft*.

On the first the native silver appears in long and thin threads, like human hair, sticking on quartz. The second is a pale yellowish pyrites, from which the silver seems to be grown ; this is the more precious for me as *Henkel*, if I am not mistaken, denies native silver to be ever found on pyrites. We are the better furnished with other scarce silver ore.

*Glass ore crystallized* extremely scarce. The miners call it here *Weich-Gewaechs* or soft ore, in order to distinguish it from the brittle glass ore. You have seen in my cabinet glass ore in cubical forms from *Siegelsberg*, and another knotty species from *Moderstohn*.

*Glass ore*, brittle, called here *Roesb-Gewaechs*, is silver mineralized with more sulphur. It contains from four to five hundred ounces of silver per hundred ; often its value is but seventy or eighty ounces. Its description in *Justi's chemical works* is exaggerated and extravagant. *Scopoli* will probably give a better account of its constituent parts.

*Red silver ore* is found at *Shemniz* and *Kremniz* either found or crystalized. That found at *Kremniz* is auriferous. On *Old Anthony de Padua Stohn* near *Shemniz*, I have met with dendritical  
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red silver ore on white quartz; and on *Rudaina Anna Stolz*, between *Konigsberg* and *Schemnitz*, I found it light coloured and sticking in pyrites. Dr. *Moller*, at *Neusohl*, has in his cabinet dark red silver ore in globular forms. *Scopoli* is likewise analyzing this sort of ore.

*White silver ore* is very common at *Kremnitz*. It is auriferous, and commonly as it were an incrustation of white quartz. The miners at *Kremnitz* call this incrustation *Blackman*; but those at *Schemnitz* give this name to the pyritical incrustations of glass ores or rocks, and it is constantly observed near the richer ores.

*Grey plumose silver ore*, from *Old Anthony de Padua Stolz*, different from the *Saxonian* species by its being cast in white quartz, not in capillary crystals but in star-like spots. There is a large vein of this ore. It takes a good polish, which pretty well sets off its star-like form, and the silver sprinkled in antimony.

*White plumose silver ore*. I am of opinion, that this species is no where else to be found. Some years ago it was very plenty in *Old Allerheiligen* mine at *Hodritz*. Its white crystals resemble the white crystalline pin-like horn ore, and stick in a matrix of iron quartz.

*Goose dung ore*, of the same form as described by *Wallerius*, *Spec.* 301, No. I. of a yellowish,



yellowish, green, and reddish colour, was dug in considerable quantity at *Windisch-Leuten* near *Shemniz*; one hundred weight yielding only 800 ounces of silver.

*Silver ocher*, of a brownish, yellow, and white colour found in the same place; containing from three, six, to fifty, and one hundred ounces of silver; the native silver often visible in it.

*Field-spath*, containing silver; of a yellow, red or white colour and hard contexture. Roasted in fire its colour changes to brown and black; but then the sprinkled quartz particles appear to fight unchanged in their colour. It contains from four to eight ounces of silver; is found concomitant with richer-ores on *Siegelsberg*, *Christina-shaft*, and other private mines. *Brunnich*, in his supplements to *Cronstedt's Mineralogy*, §. 35. has noticed already the blue colour, which appears on some species of spar in *New Anthony de Padua Stolln*, and constantly indicate a richer silver value.

*Blende*, containing silver. I do not know the globular ore, which *Cronstedt* mentions, §. 175. However, such a species of blend may have been found in former times, which were remarkably negligent of such curiosities. Nevertheless it is fact, that our blende constantly contains some silver though in a scanty quantity; and for this very reason, it is never thrown away among  
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the rubbish, but stamp like other ores. It is commonly brown, solid and of a scaly texture; however, I have found here knotty, black, yellow, green, semipellucid, whitish and several crystalline species of blende.

Lead ore, contains silver, and is commonly of a granulated or lamellous contexture. However, there are likewise several sorts of crystalline ore. White and grey lead-spar is found at *Windisch-Leuten* in the above silver-ocher. Blue lead spar found in the same place.

Copper-ore is found with other metals in the *Spitaler-vein*, but the greatest plenty in *Herrngrund* near *Neusohl*. It consists of yellow and grey copper-pyrites, fallow-ore, and copper-green.

Iron-ore is digging near *Roniz*, *Thaifolz*, and *Libeten*. Commonly it is yellow and blue hæmatites (*Cronstedt*, §. 203.) Black button-ore is considered as something rare. Such is the dripped ore from *Boinik*, in the surface covered with points or pins two inches long, each of them incrustated with blue chalcedony.

Quicksilver never occurs in a native state; but cinnabar-ores appear now and then, though in no such plenty as to deserve parting. If found concomitant to richer ores, they contain some denarii of gold. During my stay in this place they  
have



have been found on *Siegelsberg*, on the *Windshaft* and on *John's Kluft*, commonly in white loose clay.

Antimony was found last year in *Three-Kings Stolln* on white quartz, formed like stars. It is however scarce in the *Shemniz-mines*. But at *Kremniz*, in the *Rothsch-mine*, noble samples of crystallized antimony are dug out. Sound antimony with native gold, though scarce, found at *Magurka*. Red antimony said to have been found in former times on *Althandle* at *Königsberg*. The scarce antimony samples, I am possessed of, are found at *Königsberg*. One consists of fistulous antimony covered with a red incrustation; the other consists of accumulated antimony-crystals, each covered by an incrustation of white quartz. *Cronstedt* mentions a similar species.

Arsenic never offers in the *Lower-Hungarian* mines in its semi-metallic or calcareous form: For this reason our miners are less subject to diseases than those in *Bohemia*, *Saxony*, and the *Upper-Harz*. There has been however found between *Kremniz* and *Neufohl*, in a bed of grey sandstone, red arsenic of a fibrous texture.

Sulphur is found mineralized as pyrites in many different forms, as capillary, globular, undulated, dripped and crystalline. I have mentioned  
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the orpiment of *Thajova* in one of my former letters.

Vitriol drips into stalactite-like forms in the *Pacherstoln*. There is plenty of it every where in the *Old-man*, the roof and the drifts. Its colour white, green, yellow and brown. At *Herrngrund* near *Newsohl* it appears often in blue and rosy-coloured stalactites; the last species now and then mixed light blue. It generally contains within some moveable water-drops.

*Halotrichum Scopoli*, or the hair-salt, seems to me to be vitriol. I do not see that it is materially different from vitriol. It blossoms on the sides of the galleries at *Shemniz*, *Kremniz* and *Newsohl*.

I have no time to spare for a description of the many different stones and earths, which I have collected here. I am possessed of an innumerable variety of quartz and spar-crystallisations; which you shall find described in the catalogue of my fossils, intended for print as soon as I shall be settled at *Prague*.

My next from *Vienna* will tell you what hope of recovery is left me, and what curiosities deserving your attention I have met with.

LETTER



## L E T T E R XXIII.

*Vienna, Oct. 19, 1770.*

**Y**OU are acquainted with the diversions, advantages and disadvantages of this city, and the state of learning in this capital university has not escaped your observation. You complained in one of your letters, that, among so many expensive establishments for the sciences, a profession and a collection of Natural-History has been most unaccountably forgotten. If among those, who are intrusted with the reformation and improvement of the sciences, a single friend or connoisseur had hinted it, her majesty would not have neglected it, as her royal care and munificence has amply exerted itself in so many ornaments and improvements of the university. Unluckily *Van Swieten* is neither a remarkable friend nor connoisseur of Natural History; a deficiency easily to be pardoned in a man, who is so eminent in many other parts of learning.

With your observations in hand I examined the imperial cabinet of fossils. You have scarce left me any new discovery. However, you have  
over-

over-looked a great fragment of black vitreous lava found in *Hungary*. It is thrown in a corner, as deserving no great attention. They are the more particular and forward with their pretended gold-grains inclosed in raisins, with their gold incircled vines, and the gold threads, supposed to have grown as plants. But all these rarities are downright impostures. Yellow resinous sap is looked upon as gold-grains, and the pretended vegetable gold threads appear to an unprejudiced eye, what really they are, artificial gold-wires. I will allow that they have been found twisted around the vines; but might not these remains of ancient *Hungarian* dress and magnificence have been hid in the ground, by accident have been torn up with the vines, and by error have been considered as vegetable productions? This is the more forcible, because these vegetable gold rarities are generally found near *Tokay* and *Altsöhl*, places renowned in history for having been residences of *Hungarian* princes and kings, and equally known for many battles fought in that neighbourhood. Even the *Hungarians* of the present age delight in saddles, harnesses, swords, and weapons, ornamented with massy gold thread.

The collection of fine and precious stones is really admirable. I was remarkably pleased by

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the diamonds, half white and half red, or half yellow and white.

Though it is impossible to form an exact idea of the whole by a sight of a couple of hours, I did not however find here either the compleat varieties of minerals, nor the insensible gradations of varieties of different stones, nor any of those mineralogical singularities which distinguish even at first sight the cabinets of a connoisseur from those of mere collectors. So I missed likewise the greater part of the scarce minerals of the imperial states.

Mr. *Jaquin* has gathered in *Hungary* a fine cabinet of fossils. Have you seen his native gold in molybdæna from *Rhimazombat* between *Newsobl* and *Schmolniz*? The botanical garden under his inspection is likely to be very soon the first in *Europe*.

The collection of the *Minories* resembles rather to a raree show than to a cabinet of natural curiosities. I go very often to Baron *Moll*. His chosen collection of minerals, which is so remarkably rich in fine petrifications, and his explications, give me both instruction and entertainment. Pity it were if this fine collection should be separated some some day or other; but this seems to be the fate, since his sons have no inclination for this part of science.

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The collections in the academies for noblemen have afforded me great delight, not indeed by their rarities, but by their inspiring young noblemen with some relish of this science. Every nobleman in the *Theresian* college has a small cabinet of minerals, shells and insects in his apartment; and *P. Skiffermuller* spreads his taste for Natural History among these young people with great success, and very good hopes for aftertimes. This learned man is to publish the butterflies of *Austria*. The *Piarists* in the academy of *Savoye* and *Læwenburg* have of late established Professors of Mineralogy, and they think seriously of encreasing their collections.

At *Prague*, I shall be almost entirely destitute of literay company. Mr. *Peithner* is the only man, by whose science I may improve my knowledge. It is unhappy that we are doomed to live in so distant countries. If I were so free as you, my impaired health should put no stop to a trip to *Carlsrona*.

THE END.





A B S T R A C T  
O F  
M R. J. J. F E R B E R ' s  
M I N E R A L O G I C A L H I S T O R Y  
O F  
B O H E M I A.

Published in GERMAN at BERLIN, 1774





## A B S T R A C T

O F

M R. J. J. F E R B E R ' s

MINERALOGICAL HISTORY OF BOHEMIA.

Published in GERMAN at BERLIN, 1774.

Catharinaberg, *in the Circle of Saaz.*

THE mountains about *Catharinaberg* consist of gneifs, which is a mixture of quartz, mica, and white or reddish half petrified clay. This clay has been by some mineralogists considered as lithomarga; but it is commonly destitute of its qualities as described in *Cronstedt's Mineralogy*, §. 78. It is rather common clay. *Terra porcellana phlogisto aliisque heterogeneis minima portione mixta. Cronstedt, §. 78. 2.*

Between *Catharinaberg* and *Grunthal* detached columnar basaltes, common on the highway, tumbled from the adjacent hills, in which it seems to be incumbent on gneifs. \*

\* Between *Lowositz* and *Toplitz* the mountains consist generally of granites, in which red feldspath is predominant. It is striped and undulated with blackish glimmer. Columnar basaltes stands on some of these granite-hills. I have seen thereabout basalt-rock, destitute of regular prisms, but consisting in a large mass, cracked and split in many pieces, more or less angulated, and containing plenty of black shirl crystals.



The gneiss-mountains at *Catharinaberg* are continuations of the metallic mountains at *Freiberg* in *Saxony*, which consist of the same rock. They run towards the *Saxonian* upper metallic-mountains, and insensibly degenerate into argillaceous slate, as may be seen even at *Marienburg*. On the *Bohemian* side the same degeneration of gneiss is to be observed in the further run of the mountains; but it continues here longer in an unaltered state as far as *Joachimsthal*, where the veins are found in argillaceous slate, and even that extremely micaceous wherever it bassets out.

For these reasons, and in respect of its situation and extent, gneiss is to be considered as a variety of argillaceous slate; and in respect of its mixture it might, with as much probability, be considered as a variety of granites, instead of feldspath mixed with clay.

No body will disapprove of these assertions, as chemical and other observations have proved that mica (*glimmer*) is produced by clay, and resolves again into the same substance; that part of the substantial earth of clay is flinty; that clay changes into quartz and other flinty stones, which by art can be reduced again to clay in an aluminous form; and finally, that quartz and feldspath, by the action of air and age, dissolve into a white clay,

clay, for which reason many granites contain this white clay in the place of quartz and feldspath. If this clay should not be considered as dissolved quartz or feldspath, but rather as their original earth (as now and then seems to be the case) it makes no material difference. However, the dissolution is here more probable, since in the circle of *Pilsen* in *Bohemia* many hills of granite, of pure argillaceous slate, of grey micaceous gneiss-slate, and of hornslate, are observed to be affected by the air; so that their outside, for two or three feet, is changed into a white and clayish substance, which, in the granites, scarce offers any visible mark of their former constituent parts of quartz, mica, and feldspath; nay often they loose their very hardness and stony concretion, so as to appear dissolved and mouldered into a white, loose and soft clay, in which but a few mouldering quartz- and feldspath grains, with some mica lamellæ, are to be distinguished; the latter changed from their black and glossy brightness into a pale silver-colour. Few of these stony granite-particles are visibly remaining in this clay; there are however enough to prove its being a solution of granites, which is the more easily to be granted as granite in itself is composed of argillaceous sub-



substances. † Similar argillaceous solutions of the pure, micaceous and gneissy clay-slate are very common in the circle of *Pilsen*. This white clay is dug for example near the new inn in the neighbourhood of *Ostraw*, near *Innickaw* and in several other places; and it is made use of in common

† Having in the year 1753 visited and examined the *Blockfberg*, which is the highest mountain in the *Harz forest* and in *Germany*, I found it in its whole extent and wide spreading ramifications, consisting of grey granite. Where this rock rises above the metallic slate of the *Harz-mountains*, it appears, either entirely naked, or more or less covered with swampy combustible flaw turf, produced by rotten vegetables. On the very highest summits of this famous mountain and on its wide branches, such as the *Little Blockfberg*, the *Heinrichshobe*, the *Bruchberg*, the *Rennekenstein*, and many more, the granite appears in immense shattered masses, confusedly piled up—Vast ruins of a former world. In the deeper valleys it appears sound and stratified. The air has visibly affected its hard substance, in changing the colour of its outside, in lessening its hardness, where most exposed to the inclemencies of the weather, nay, in dissolving it into more or less coarse sand and clay. Large beds of this *granite-sand* have been washed down in the valleys, on the slope of these mountains, and to the foot of the most exposed mouldering rocks; nor is there want of *granite-clay*. As the mica in these granite decays is often of a yellow brass or white silver-colour, times immemorial these decays have been considered by the inhabitants of these wildernesses as gold-and silver-ores. The colour of these sands and clays, or pretended ores, differs according to their different solution,

mon pottery, nay, on account of its white colour, it is employed as lime in the washing, whitening and incrustating of houses and walls. If this clay be found in such beds, as basset out or are exposed to the day water, then it is commonly mixed with heterogeneous matters, and its colour is accord-

solution, mixture and position, as Mr. *Ferber* has very justly observed. I found on the highest summit of the *Blockberg*, near a rock, which is called the *Devil's-Chancel*, a fine pale yellowish clay, and a reddish species in another place, which imparted to the hands, when rubbed with it, a fine silver-or gold-glittering. This visibly derives from the fine solution of the mica, and, together with the remarkable saponaceous softness of the clay, forcibly causes me to say something of the finer *China-clay*, as having the same qualities. 1. I know that a very fine and white species of *China-clay* has been discovered of late in a vein, which crosses the granites in the *Bruchberg*, connected with the *Blockberg*. I know, 2. that the *Petuntse* of the *Chinese* is a more or less decayed granites. And 3. that the *Kaolin* of the *Chinese* has been considered by many as the substantial earth of granites. Therefore I should be inclined, and think myself intitled to conclude, “that *China-clay* is but a fine solution of decayed granite; that there is a good chance to find *China-clay* in or near any granite mountains; nay, that perhaps such a clay may be produced by proper artificial decompositions of the granites.”

Whether the quartz or other fine sand, which covers so large and extensive parts of the world, and of the sea-ground, may be ascribed to dissolved granite-mountains or not? is a question which I cannot pass silent. The many detached granite-



accordingly brownish or yellowish. Sometimes these colours may be owing to a stronger iron-mixture of the rock, or to the yellow brownish clay-slate, which is not uncommon in these parts. These sorts of clay, the white as well as the yellow, turn red in fire, the white less than the yellow, which evidences its being less impregnated with iron than the latter. The yellow clay is used as common loam in walls. In a great part of the circle of *Pilsen*, and on the frontier mountains towards the *Upper Palatinate* and *Bavaria*, the vegetable mould, or the upper strata of the ground, are extremely loamy. Unless they be accumulated by river-inundations, they may be properly considered as produced by solutions and decays of the adjacent granite and other argillaceous hills, which will, I am confident,

granite-pebbles and rocks, which are so frequent in these sandy plains, seem to favour such an opinion; and as among the pebbles of the sea-shores, besides these granite-pieces, a great variety of the harder remains of the more ancient mountains, nay of different secondary ones, are to be found, such as jasper, porphyry, various coloured hornstone, quartz-lumps, gneiss, hornslate, marble, limestones and flint, which prove that nothing stands proof of age and time; this opinion gains some credit, and this the more so, as hitherto no sort of rock has been discovered, in which a greater quantity of visible quartz be contained. The pure parasitical quartz, deposited in the veins, would prove, I think, insufficient to cover half the world with sandy plains. (Transl.)

account

account likewise for the similar nature of other countries.

In those places where the granites is not entirely dissolved into clay, but mouldered only to pieces, a brownish sand is produced, similar to that which occurs on many shores, and which is perhaps owing to the same causes.

But now the question arises, how nature operates these argillaceous solutions of the rocks? No body indeed will question the co-operation of the air and the long series of ages; but how acts the air? If I was allowed to recur to the general acid of the air, I should have done very easily with my explication, since I have seen the sulphurous acid in *Italy*, issuing from the old volcanos, change even the black and vitreous lavas into a white and aluminous clay. But the vitriolic acid in the air begins of late to be controverted, unless vitriol-works and other vitriolic exhalations account for its presence. However, I cannot help observing the similarity of these solutions of lavas, and such rocks as contain quartz and feldspath; and accordingly I am of opinion, that nature operates them in the same manner. It is fact and experience that air softens any rock whatever; why or how? that I leave to future examinations. But as the rocks, I am speaking of, turn to white clay, it seems to me owing to the acid of their own argillaceous mixture, since by Mr. *Beaume's* excellent



excellent Treatise on Clay it appears, that clay consists of vitriolic acid, connected with flinty or vitreous earth, and according to Mr. *Poerner's* annotation, with some phlogiston. Now supposing these rocks or stones to be successively softened or loosened, and the acid of their substantial mixture by humidity or other causes to be set in motion; the same phænomenon ought to arise, which the acid steams produce in the lavas. Vitriolic pyrites, after having undergone several elixiviations, continues to produce vitriol, when exposed for some time to the air. The reason is, not, what the ancient chemists supposed, that it attracts new acid from the air, but that its own still fixed and unactuated acid is by the air set at liberty, in motion and in activity, to separate from the phlogiston, and to corrode the metallic earth. This phænomenon is called the *mouldering* (*verwitterung*) of the pyrites; and the similar alteration of the above rocks goes justly under the same name. Their acid forsakes the phlogiston or other mixtures, which fixed it; it spreads now in the loosened stone, acts upon the vitreous earth, unites with this earth and produces clay.

But I have deviated too much from my subject, and return therefore to the gneiss-mountains at *Catharinaberg*. I said that they are to be considered

considered as continuations of the *Freiberg* gneiss-mountains, and of the *Saxonian* and *Bohemian* argillaceous slate-mountains; or, which is the same, that the whole tract of the *Bohemian* and *Saxonian* mountains, which consists of gneiss and clay-slate, is the same stratum. Besides I have endeavoured to shew, that the difference of clay, slate and gneiss is not against this assertion, since their constituent parts are substantially and really the same; and that the same substantial earth, which in the upper metallic mountains produced clay-slate, has under other accidental circumstances and mixtures produced gneiss in the lower metallic mountains at *Freiberg* for example, and at *Catharinaberg*.

This gneiss and argillaceous slate is in *Bohemia* and *Saxony*, as in many other countries, incumbent and accumulated on granites, and is in several places covered with limestone; which fully confirms the observation, that the prevailing and general rock-strata in the greater and higher *European* chains of mountains consist of three different sorts of stones. The lowest and undermost and most ancient, which in the highest tops appears bare and naked above ground, is granites; the second sort accumulated or incumbent on the granites is clay-slate, gneiss or some other argillaceous rock; the third is limestone. These general



neral and more ancient strata of our part of the world are covered with several beds, which are of a more modern date, and consist of clay, calcareous earth, marle, sand, or that slate which lies in flats over the coal-beds, and is never to be confounded with the slate of primitive and older mountains, in whatsoever degree they may resemble each other in their composition and substantial earth. The physical observation of the mountains, of their situation and beds, of the different time of their origin, of their connexion and their various accumulation is carefully to be distinguished from the chemical and mineralogical examination of their constituent parts. A new stratum may very often consist of the same earth or rock as the lower, more general, and more ancient ones; and notwithstanding the similarity of their substance, they may have been produced in very different times. On the contrary, it seems to be consistent with the nature of things, that the same stratum, whatsoever extensive it be, consist of the same rock, if produced at the same time, or if this rock be found changing in a certain distance, that then it consists of such rocks that are similar in their constituent parts, as gneiss and slate. For this reason I have endeavoured to shew their similarity; and notwithstanding granites consists of the

the same constituent argillaceous parts, it does not belong to the same stratum but to a lower and more ancient one. Many remarkable facts in the following description of the *Bohemian* mountains will demonstrate it; but it would be matter of an extensive work if I should attempt particular accounts of all the facts, which evince in *Bohemia*, that granites, clay slate, and limestone are constantly in that situation which I have indicated before. It would engage me to give a general view of the *Saxonian* and *Bohemian* metallic mountains, and of their run in the plains on both sides. That would require a particular physical geography of all the mines at *Johan Georgenstadt*, *Joachimsthal* and *Platte*, and of all the vast mountains between *Prague* and *Dresden*. I have hinted here only a fact, which I could not pass over silent. The evidences will appear in the sequel, and may perhaps be given some day by me, if abler men should not prevent me from doing so. But being again astray I beg leave, before I return to *Catharinaberg*, to obviate some objections, which might be perhaps opposed to this theory.

Though it is an undoubted fact that slate is accumulated on granites, and limestone on slate; though it is likewise fact that these three sorts

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of rocks are the most ancient, most extensive, and most considerable strata of the world, as far as we have explored its depth: there are however many other more modern, thinner and accidental beds, which either cover single parts of the above primitive mountains, or are accumulated in the valleys and gutters, or on the slope of the higher mountains. We need not believe nor pretend that granite should be every where covered with slate or limestone. No; there are in the contrary many places, in which it appears bare above ground, and in which it rises to the side of the adjacent accumulated and superincumbent slate or limestone-mountains. In the same manner slate appears often naked above the limestone. It is indifferent whether this have been so from the beginning or whether this may have been produced by inundations, earthquakes and other accidents, which have taken away their incumbent roof; nor does it alter at all the above rule of the three sorts of incumbent ancient rocks.

Let us suppose that a granite-mountain, within the verge of the greater mountain-chains of *Europe*, be covered by limestone, this calcareous stratum ought to be considered as produced either in later times by a particular and partial inundation, or if really it should belong to the third general and old limestone rock, the granite is to be supposed having appeared naked above the  
slate

slate before this general limestone bed was accumulated; which very well accounts for the imaginary difficulty of the limestones being found now and then immediately incumbent on granites. The pre-existence of the granites before the slate, and that of slate before the limestone, cannot be controverted, since they are incumbent on each other. No architect can lay the roof before having laid the foundation.

Before I can go on I have still a previous remark to recommend. The examination of the physical origin, and of the common substantial parts of several rocks, shews their great similarity and their insensible degeneration, as I have evidenced above by the example of clay-slate, gneiss, horn slate, granite, quartz, mica and feldspath. Hence in mineralogy, and the description of mines, arises an indispensable necessity to distinguish by constant names, the different degrees and varieties of the rocks. The name of *gneiss* should never be given but to the rock, which visibly contains the three above substantial parts of its mixture; and that variety, which contains only mica in grey petrified clay, and which is destitute of quartz, should constantly go under the name of *grey micaceous slate*. I allow this to be a violent distinc-



tion forced upon nature, since the three substantial parts of gneifs are not constantly visible, (which is the case at *Freiberg*) and grey micaceous slate is very often found with gneifs in the same mountain; for being nearly related to each other, I cannot help wishing that the utmost care be taken in their denomination. Mineral bodies, I know very well, are not differenced by nature into different classes and families, as plants and animals; they are but different varieties and different mixtures. Nevertheless it is better to distinguish by words and intellectual distinctions things, which can be distinguished, than to confound them and to be in want of proper expressions.

The mines at *Catharinaberg* are in the *Stadtberg*, which in its length runs between hour nine and ten of the compass, has a valley on both sides, and is of about 340 fathoms diameter. Commonly the veins run in a direction which is parallel with that of the valleys and the mountains; but in this place three noble veins, and several insignificant fissures, run a-cross the mountain in hour two of the compass. These are the *Nicolai*, the *Calves head*, and the *Elizabeth* vein.

The *Nicolai* vein dips somewhat sliding or slipping, (*tonnlegig*) § has no distinct side-skirts (*saalbänder*)

§ The dipping of veins and fissures is determined by their angles and inclination to the horizon, and accordingly measured

*bænder*) and is almost insensibly blended with and cast in the mountain sides. The vein-rock is commonly gneiss as the mountain; but now and then it consists of a species of granite. The gneissy-mountain-rock breaks and splits parallel to the dipping of the vein; but if veins between hour six and nine unite or cross the main vein, the gneiss next to the vein gets or affects a situation, which is parallel to the dipping of the cross-vein. Wherever the mountain-rock turns harder and sounder, the vein turns smaller and thinner. It is commonly not above one foot wide. A reddish iron clay soaks through the vein and incrustates it. This commonly appears in the neighbourhood of richer ores. Fissures from the hanging are measured by a quadrant. The *German* miners give them different names, which are expressive of their different inclination to the horizon.

A *vertical or standing* vein dips or falls from ninety to seventy-five degrees.

A *tonnlegig* vein dips or falls from seventy-five to forty-five degrees; and has this denomination from *tonn* or *tun* and *legen* or *lay*, implying, that *tuns* or *casks* or *barrels* laid on the hanging of such veins, sink by their own weight to the bottom, and that accordingly shafts might still be sunk in them, which is a great advantage to the works. For this reason I should not scruple to call these veins *sliding* or *slipping* veins; as that denomination answers the idea of the *German* miners.

*Flach-fallend* veins dip from forty-five to fifteen degrees; and might very well be englished by *flat veins*.

*Schwebende Gaenge* dip under fifteen degrees, and I do not scruple to call them *soaring veins*, as this denomination exactly answers the *German* name.. (Transl.



or from the hading, uniting with the vein, improve it. White fine clay with quartz is a forerunner of rich ore ; coarse white clay destitute of quartz forbodes no good, fills at last the whole vein and strikes it deaf. Crossing veins between hour six and nine are pretty common ; alterate the direction of the vein ; contain some quartz ; are deaf in themselves, nay strike deaf the vein unless it be strengthened by fissures from the east. In this case the cross-veins bring rich ores, which in the hading are commonly richer than in the hanging ; but these richer ores are only to be found within the cross.

These observations of the *Nicolai* vein stand in general for all the veins at *Catharinaberg*.

The ore consists of rich silver and copper-pyrites with blue fluor, blende, copper-glass, copper-green and sometimes with some native silver and copper.

### *Commotau in the Circle of Saaz.*

THE mountains from *Catharinaberg* to *Rottenbahn*, *Commotau* and *Sonnenberg* consist of gneiss, which in many places is fine micaceous and greatly quartzous. Some granite rocks appear in these parts above ground. Near  
the

the alum work at *Commotau* the gneiss changes into that argillaceous slate, which is commonly found with coals. It is much impregnated with vitriolic acid, and properly roasted produces alum. Impressions of vegetables are not uncommon in it, and it is to be questioned whether it might not be considered as a variety of gneiss, or whether it be owing to a later origin, and to an accumulation in some valley or sloping ground of the more ancient gneiss, which is more probable. However, the aluminous slate at *Tolfa* in the *Roman* state belong to the simpler or pretended primogenial mountains.

This slate is in the open fields put in square pyramidal piles, fired and roasted. Once fired it continues burning by itself; and is left so for some weeks till it is quenched by water. Its black colour is then found changed into red. During a year it is left exposed to the air, and then three times successively elixivated; each elixivation lasting about twelve hours. The elixivated slate is during six months left in the air, till it be brought to the second, and after a similar dissolution in the air to the third elixivation. At the first boiling of the brine it is mixed with urine, and in the lead pans evaporated to a farinaceous powder; which afterwards is dissolved in fresh water and by two successive boilings brought to crystallisation.



In former times they boiled likewise vitriol; but it was found unprofitable. The annual produce of alum is about 200,000 pounds, which, on account of the great number of alum-works in *Germany*, sells at a lowered price of twelve florins per hundred weight. The other *Bohemian* alum-works at *Eger* and *Tans* are of no importance.

These alum-works induce me to mention the *Bohemian* sulphur and vitriol-works. Those at *Alsfattel* in the circle of *Saaz*, at *Nassaberg* and *Großluckowiz* are the most remarkable. The pyrites, after its sulphur is extracted by firing, is elixivated for vitriol. At *Kupferberg*, in the circle of *Saaz*, there might be produced towards 100,000 pounds of blue or cyprian vitriol; but there is no opportunity for sale, tho' the price be lowered to fourteen florins per hundred weight.

#### *Prefniz in the Circle of Saaz.*

THE mountains consist of gneiss, which is white silver-coloured, blueish or dark-coloured. Detached basalt-prisms shew that basalt is not wanting. They work here for silver and iron. 1. The silver-mine *Maria Kirchbaw*, is in a vein running to the south, betwixt the hours twelve and one, and containing reddish ponderous gyps-

gyps-spar. In the deeper drifts native silver, and in the uppermost ones, nay to the very turf, other rich silver ores are said to have been found of old. Even this gypseous spar is supposed to contain some silver. It serves as a fluor in the copper furnaces at *Catharinaberg*. To the south the vein is found; but to the north, in the sloping of the mountain, it is shattered and deaf. A vein in which the gallery or drain was driven has united with the chief vein under the shaft, but without improving it.

The works are carrying on rather for the fluor, and for hopes, than for any present remarkable produce of ore.

2. *Orpes iron-mine*. It is a common observation, that flats commonly begin on the foot of simple, more ancient or pretended primogenial-mountains, where they sink under the adjacent plains. However, the existence of flats in the midst of ancient mountains, and in their valleys, appears among several other evidences by the nature of this iron-work at *Orpes*, and sundry others more to the north, which produce the same ore and are under similar circumstances. Partial and accidental inundations, as well as the successive washing down of the decays of the neighbouring more ancient and higher mountains, will pretty well



well account for this phænomenon. || At *Orpes* the undermost or lowest ground is gneiss, on which a large bed of scaly limestone is accumulated and incumbent. This is covered by a soaring vein or a bed of iron-stone thirty fathoms thick. The whole is buried under a white argillaceous stone striped

|| One of the most remarkable flats of this kind, which is undoubtedly a marine bed, has been more than once examined by the translator. It is in the *Harz* forest between *Zellerfeldt*, *Altenaw*, and the *Calenberg*, in the midst of ancient mountains, and appears there in several places near the *Festenburg*, the *Schulenberg*, and the *Calenberg*, not only in deep valleys as Mr. *Ferber* supposes, but even on and near the top of the higher ancient slate-mountains. Such is its situation on the sides of the *Calenberg* and the *Schwarzeberg* towards *Altenaw*, and remarkably so near an inn, which is called the *Auerbahn* in a quarry known there by the name of *Shalke*. The translator therefore is of opinion, that this flat or marine bed, as many others of that kind, is rather owing to more general revolutions and causes than Mr. *Ferber* seems to admit; though the partial causes, alledged by him, may be without dispute admitted for those secondary beds, which are destitute of marine bodies. The secondary marine bed on the higher *Harz* mountains is a very instructive phænomenon. It consists of fine sandstone, commonly white, compact, fine grained and pure; and so it is found in the *Shalke*, and is cut into the form of grinding and scythe-stones. But in several places it is of a greyish or brownish colour and mixed with some fine mica flakes. Such it is commonly near the *Festenburg*. It contains a great variety of fine impressions of scarce and most part unknown

striped with mica, to the thickness of seven fathoms.

The above large soaring iron vein, if not rather iron stratum, contains the finest iron-coloured ores, which resemble the *Swedish*; such as *ferrum refractorium mineralisatum, tritura atra, textura chalybea*. LYTHOPHYL BORNIAN, p 124.

*Ferrum refractorium, textura granulata, granis minimis. Ibid.*

known marine sea-bodies, as of *Asteriæ columnares rotundæ perforatæ*.

*Asteriæ solutæ solares,*

*Ostreo pectinites anomius vespertilio alatus*, whose impression produces a species of hyfterolithus.

*Ostreopectinites anomius planus latior*, whose impression produces a species of hyfterolythus, peculiar to this place.

*Entomolithus paradoxus, trilobus transversim rugosus*; or a new and undescribed species of Cacadu or *Dodsfley*-fossil, peculiar to this place.

*Conchæ minores læves*; and *Cochleæ* and *Buccinitæ læves minores*.

The decays of this remakable sandstone bed appear many miles on the other side of *Goslar*, in the plain country near *Kloster Grachof*, and towards the *Steinfeld*, in detached dragged and blunted sandstone pieces, filled with the same petrifications which are scarce in themselves, but the more so as included and moulded in sandstone, which is commonly destitute of petrifications. I forbear in this place to draw consequences from this singular fact; which, obvious in themselves, prove to conviction that very violent causes have co-operated to raise and to destroy our highest mountains. (Transl.)

which



which are found with fherl, garnets, wolfram, mica, hornblende, grey amianth, green fudflag, (*Cronstedt Mineral*. §. 106. *Wallerii. Mineral*. Edit. 2. p. 398. 5 & 6.) and a deaf irony green clay, in which all these minerals are commonly sticking.

The scaly limestone, which is the hading or the floor of this iron-vein or bed, is grey towards the south. In both places it bassets out.

The white argillaceous stone, striped with mica, which is the hanging or the roof of this vein or bed, seems to be produced by the decays of the adjacent mouldering higher gneiss-mountains. This successive accumulation is supported by several argillaceous beds in the neighbourhood, ¶ and by many pieces of fossil wood, which are penetrated with iron, and are so frequent in the upper flats of the argillaceous ground near *Orpes* that even some good iron is extracted from them.

¶ Near *Presniz* they dig in a gallery a green painters clay *Cronstedt*, §. 79, and near *Kaaden* white *China*-clay, with a white grey, milky, opaque, argillaceous stone, which is smooth and glossy in its fractures and a production of the *China*-clay, as appears by the loose clay contained in its middle. Mr. *Peithner* has described it in his *Mineralogical Tables* under the name of *Porcellanites*- *China*-clay is found in several other places in *Bohemia*, for example, at *Lumpe*, near *Boehmisch Gieshubel*, at *Zitolib*, on *Sonnenwirbel* near *Weipert* at *Laun*, *Marklin*, *Hlublofs*, &c,

Weipert

*Weiperth in the Circle of Saaz.*

THE following mines are working here for silver and cobolt. 1. *Clementis-Stolle*. The mountain rock is gneifs; the vein not opened yet. Where it baflets out they have found under the turf a species of very rich brown silver-ore. It seems to have been horn-ore; but want of knowledge and curiosity has destroyed it by unconcerned fmelting. The ffituation of the ground did not permit to drive the gallery in the vein; they have therefore driven it in the gneifs, but fo unwifely, that they have not thought neither of a place where to put up the rubbish, nor of the neceffity to include the brook which runs before the entrance, and of courfe overflows it as often as it fwells by fudden fpring-or autumn-waters.

2. *S. Anthony Stolle* is driving in the vein, in a gneifs-mountain. On the fole of the gallery the hanging is flate, and the hading gneifs. This flate is a branch of the neighbouring metallic mountains in *Saxony*, and a variety or degeneration of the gneifs, which appears clearly in this place, where they border together. They have found in this gallery fome silver and cobolt.

3. *S. John*



3. *S. John in the Desert.* The vein runs in gneifs.

*Joachimsthal in the Circle of Saaz.*

ALL the *Bohemian* metallic mountains, from *Catharinaberg* hither, consist generally of gneifs, which is a mixture of visible quartz, mica and a whitish clay. Near *Joachimsthal* this visible difference of the constituent parts disappears, and they are so closely mixed together, that the rock thence produced is to be called grey micaceous and quartzous clay-slate. It is the common rock of all the mines at *Joachimsthal*, and turns less micaceous in the depth, where it is more argillaceous, soft, lamellous and black, and the more resembling to the argillaceous slate of other metallic mountains, especially those at *Clausthal* in the *Harz forest*. However, the grey micaceous clay-slate continues in some mines to a great depth before it changes its nature.

The metallic mountains at *Joachimsthal* are towards the south of a gentle ascent, run in different ridges to the east, to the north, and to the west (the highest being that which runs to the north) and to the frontiers of *Saxony* sink down again in the plains. The valleys between these ridges are extremely deep; accordingly the hills are remarkably

ably high, which has afforded to the miners a good opportunity to work many galleries, which from every side converge to the south, and to the valley in which the city of *Joachimsthal* is situated.

These ridges are to the south; the *Adelsgreen*, and the *Little Mittelsberg*; to the north-east rises the *Turkner*, and in the west the *Pfaffenberg*; to the east is the *Hobeberg*; to the west the *Upper-Turkner*, the *Shottenberg*, the *Koblberg*, the *Keilberg*, and the *Under-and Upper Niclasberg*. All these hills are very steep, and naked. Their exterior mould is sandy and barren. The facility of working by galleries has induced the miners of old to search the numerous veins from every part. Hence that astonishing number of old galleries. Above forty of them are still working, and many of them, for example the *George* and the *Theresia* stolln are driven a length of 450 fathoms.

All these galleries and works of *Joachimsthal* are divided into six different fields, and belong to the following companies their tenants.

1. *Unity*, belongs to the community of the citizens at *Joachimsthal*.

2. *Hobe Tanne* is belonging to the imperial court.

3. *Hubert* or *Helena-Hubert*.

4. *Friedenfeld*.

5. *Schweitzer-Gewältigung*, divided between the court and private companies.

6. *Sächsisch*,



6. *Sächsisch Edelleuth-Stolln*, and *Apple-tree-Stolln* at *Abertham*, belongs to private associations.

All of them are drained by two deep canals or levels, *Barbara* and *Daniel*. The former has its door in the city, and including its several wings is driven 4,500 fathoms. In a direct line it is 1600 fathoms, and its sole is 170 fathoms perpendicular under the highest top of the mountain. It was the deepest gallery of the ancients. *Daniel* is, including its wings, driven 5600 fathoms, and in a direct line 1500 fathoms. It runs twenty fathoms underneath the sole of *Barbara*, empties under the town more to the south. These draining-levels are kept in repair by the court, for an allowance of a ninth part of the profits.

There are but three drawing shafts for all these mines. *Hoke-Tann* dips somewhat sliding nearly in 73 degrees. Its whole depth is  $60\frac{1}{2}$  fathoms. *Unity-shaft* is 154 fathoms perpendicular. *Hubert-shaft* is 70 fathoms perpendicular. Hence arises the necessity that these shafts serve by alternate turns to different mines and associations.

The works are every where sunk much underneath the sole of these shafts and galleries, so that these mines, after those in *Tyrol*, are the deepest in the world. They have from 200 to 350 fathoms perpendicular depth under the turf.

Considering

Considering the situation of the high and steep hills, which go under the collective name of the *metallic-mountains* of *Joachimsthal*, and which are separated by deep valleys, one would be inclined to think that the ascent, fall, and direction of their rocks and veins must be corresponding with their exterior form. That is commonly the case in other metallic mountains. But here, contrary to such observations, the rock generally ascends from the south, and sinks either to the west or to the north, as in some respect will appear by the run of the veins, which is absolutely unaffected and undisturbed by the direction of the valleys, except that it seems to influence their quickness.

These veins are very numerous; they fall into an indefinite depth, and continue quick and metallic 350 fathoms. In respect of their general run and direction, they are by the *Bohemian* surveyors and engineers divided into *midnight* and *morning veins*.

The *midnight* or *northern-veins* run from south to north, between the ninth hour and three, dipping from east to west from 54 to 78 degrees, being in general *sliding veins*.

1. Gold-rose hading fissure runs in

hour — — — 1 : 6  $\frac{1}{4}$  line.

2. Gold-rose hanging fissure runs in

— — — 12 : 5  $\frac{1}{2}$

S

3. Francisca



3. Francisca	—	—	9 :	line.
4. Anna	—	—	8 :	7
5. Fundgrube	—	—	12 :	$6\frac{1}{2}$
6. Backer-vein	—	—	1 :	$7\frac{1}{2}$
7. Hilbrandt	—	—	12 :	$6\frac{1}{2}$
8. Geshieber	—	—	10 :	4
9. Rose, from Jericho, in hour			2 :	3
10. — —			hading fissure	1 : 3
11. Joseph	—	—	12 :	$1\frac{1}{2}$
12. Bergkitler-vein	—	—	1 :	$2\frac{1}{2}$
13. Schweitzer	—	—	1 :	$2\frac{1}{4}$
14. Ioung Schweitzer		—	2 :	$4\frac{1}{4}$
15. Jerome	—	—	1 :	$7\frac{1}{2}$
16. Geister-vein	—	—	12 :	4
17. Flat-vein	—	—	12 :	7
18. Mathefi-vein	—	—	2 :	2

The *Morning* or *Eastern*-veins run from east to west between hour 3 and 9, dipping from south to north from 60 to 73 degrees, being all of them *sliding veins*.

1. Lawrence runs in hour	—	5 :	$1\frac{1}{2}$ line.
2. Francis de Paula	—	5 :	5
3. Joachim	—	6 :	$0\frac{3}{4}$
4. Sufann	—	6 :	3
5. Kayferthum	—	6 :	$3\frac{1}{4}$
6. Corona	—	5 :	2
7. John in the Defart	—	6 :	$0\frac{1}{2}$
8. Ursula	—	6 :	$6\frac{1}{4}$

9. Three

9. Three Kings	—	—	6: 5 $\frac{1}{4}$ line.
10. Hutten plan	—	—	6: 4 $\frac{1}{2}$
11. Morice	—	—	6: 2 $\frac{1}{2}$
12. Seegen-Gottes	—	—	5: 7 $\frac{1}{4}$
13. Geyer	—	—	5: 7 $\frac{1}{2}$
14. Andreas	—	—	7: 2 $\frac{1}{4}$
15. Trinity	—	—	5: 7 $\frac{1}{4}$
16. Heer-Paukner	—	—	7: 0 $\frac{1}{2}$
17. Fundgrubner	—	—	7: 0 $\frac{3}{4}$
18. Spathgang	—	—	7: 2 $\frac{1}{2}$
19. Cow-vein	—	—	7: 0
20. Wafferstolln	—	—	6: 6
21. Michael	—	—	6: 4 $\frac{3}{4}$
22. James Major	—	—	6: 6 $\frac{1}{4}$
23. Rosner	—	—	6: 0 $\frac{3}{4}$
24. Elias	—	—	7: 0 $\frac{1}{2}$
25. Saxen-Kerl	—	—	6: 3 $\frac{1}{4}$
26. George Stolln	—	—	6: 3 $\frac{3}{4}$
27. Old Saxen-Kerl	—	—	7: 3 $\frac{1}{2}$
28. Tirre Schonberg	—		6: 1 $\frac{1}{2}$
29. Himmels-Krohn	—	—	7: 0

There are besides them many other midnight and morning-veins, either uniting with the former, or running by themselves; but not having been yet examined they are still destitute of proper names.

In order to give a general idea of the mines at *Joachimsthal* I have annexed a general map in plate, I. The richest veins are among the nor-



thern ones : *Geshieber*, *Fundgrube*, *Rose from Jericho*, *Berg-Kittel* and *Jerome* ; among the morning ones, *Morice*, *Geyer*, *Andreas*, *Cow-vein*, *Elias*, *Old-Saxon-Kerl*, and *George Stolln*.

The vein rock in the northern as well as the eastern veins is ashgrey, yellow, white or blueish clay, argillaceous slate, and various coloured but commonly red hornstone (*petrosilex*) which is the matrix of the richest ores. The *Rose-spar* is a calcareous spar, consisting of accumulated roundish and twisted lamellæ, found in the vein called *Rose from Jericho*. The midnight or northern veins contain for the greater part a very fine red hornstone, semi-pellucid and of a pleasant colour. It has not yet been found in any morning vein. As soon as this red hornstone appears the clay breaks off, but presently returns at the end of the hornstone. They are constantly alternating, but seem to be of the same substantial mixture.

The *Paukner-vein* has not shewn any thing yet but slate intermixed with arsenical pyrites.

The *Fundgrube* is either entirely filled up with flintlike grey hornstone, or holds it in nests and nodules.

The width and thickness of these veins are various, from one inch to two feet. The same vein appears very different in its thickness ; they  
are

are often so much compressed that no vein but a simple joint only is to be distinguished. The hardness or softness of the mountain-rocks have a share in it; nay, the mountain and vein rocks turn softer as soon as the vein itself turns quicker and nobler.

The veins do well in general in the ascent of the mountains; and richer ores are ever to be expected in the crossings of the northern and eastern veins. If both veins be filled with clay there is no chance of ore.

If one be filled with quartz or calcareous spar, and the other with hornstone, the ores turn rich in the crossing; infallibly if two veins, one argillaceous and the other hornstone, by dipping cross one another, rich ores are produced.

In these crossings the veins are now and then disturbed in their run and dipping, and if they do not improve they are shattered.

Ramifications or fissures separating from a vein, and uniting afterwards to another, raise its value and thickness, especially if they should happen to unite with it in an acute angle, and continue to run with it for a considerable length. This happened in the *Geyer*, where they



have at present a prospect of the richest ores. However, the contrary happens likewise, and veins have been by the uniting fissures so much compressed and shattered, that scarce any track has been left remaining; then experience has taught, to trace the run of the destroyed vein by that fissure, which contains a thin covering of clay one single line thickness.

The fissures of the *Rose from Jericho* in the haiding are scarce ever worth working, though commonly larger than the vein itself.

Besides these metallic veins some deaf ones, of a considerable thickness, go a-crofs these argillaceous and metallic-mountains. They are called here *combs* (*kæmme*) and deserve particular notice. Some of them consist of red *porphyry*, which is called here sandstone, and some of a species of trapp, which is called here wacke.

The *porphyry* consists of a red flesh-coloured hornstone (*petrosilex*) and milky feldspath grains, in which sometimes vitreous quartz-grains may be distinguished. In some places this *porphyry* is soft and unpetrified. Then the feldspath grains are cast in a reddish loam. So I found it in the *Kubgang*. Some large veins or combs of this porphyry cross the metallic mountains at *Joachimsthal*, commonly from south to

to north. They unite with the veins, run parallel with them and cross them, now and then improving their metallic value. Such a porphyry vein is next to the *Cow-vein*; two of them are close to the *Schweitzer*, one near *Elias* on *George-Stolln*, but the largest, and till yet the only improving one, has been found on the *Rose from Jericho*. Here it has in the hading united with the vein, and has produced the richest glass-ores which ever have been dug in this mine, but broke it off with the porphyry. The whole width of this porphyry-comb has not been explored it is supposed to be at least eight or ten fathoms. In its cracks and fissures this improving porphyry-comb contained a remarkably fat clay; nay the porphyry softened by it as other vein-rocks turned rich.

The *Combs*, consisting of a species of *Trapp* or hardened irony clay, are commonly of a grey and greenish colour. Some are black, and in this species white calcareous spar-grains and greenish sherl are found in the *Cow-vein in the Unity*. Their run is very regular. Their width and thickness from some inches upwards to forty fathoms, remarkably large where they basset out. They unite, run parallel with the metallic veins, and cross them either to their improvement or to



their various disadvantage, striking them deaf, altering their run, or compressing them so as to be with great pains to be found again. Under ground these combs are often so hard that they cannot be worked but by blasting; but crossed by galleries, or by other accidents exposed to the air, they wither and moulder into that argillaceous earth which formed them, change their colour to yellow and ochraceous, and turn very saponaceous. This clay for the greater part dissolves in water. In respect to their run and direction they are hereabout as other veins called *Morning* or *Midnight-Combs*. The former cross the metallic midnight-veins and dip from north to south. The latter cross the metallic morning-veins and dip from east to west. Some of them are entirely perpendicular.

There have been found above thirty *Morning-Combs* which basset out. One of them *Schon Erz* is thirty fathoms where it bassets out. Five such *Wacken-veins* have been crossed by the works between the *Cow-vein* and *Elias*. The *Rose from Jericho-vein* is crossed on the level of the *Daniel-Gallery* by three such combs, fourteen, nine and eight inches, two of them twenty fathoms deeper have united together, and with the vein, which  
has

has been so much improved by this accident, that *Wismuth* has begun to break in the hading.

The *Midnight-combs* or *Wacken* commonly disturb the run of the metallic morning-veins. The *Cow-vein* is crossed by three large combs; two of them are on the *Theresia-drain* near the *Geyer*, under ground from some inches to six feet; but where they basset out they have a thickness from thirty to forty fathoms. The third comb is grey, and on the *Barbara-Sole*, between thirty and forty fathoms. In this place, which is 150 fathoms perpendicular depth, and about 3000 fathoms distant from the door of the gallery, they found of old, that famous antidiluvian tree, which is the more remarkable as it lay in the midst of these slate rocks and the comb I am speaking of. The exterior appearance; the inner stripes or fibres; the concentric circles; the ramification of this substance into round branches; the soft bark which stuck to them; and something like leaves found in several parts of this grey stone, or even on this substance itself; in short, every visible circumstance convinced the first discoverers of their having found one or more petrified trees in the midst of the mountain; and the pious simplicity of these former times, which considered the most natural phænomena as prodigies or signs of divine warnings, dared not consider these  
trees



trees but as having been buried here by the deluge, as appears by the name of this petrified wood, and by the different accounts of *Matthesius* in his *Sarepta*, and in his *Chronicle of Joachimsthal*. Soon after this discovery the water prevailing, and this whole drift of the cow-vein giving way, it has been ever since either impossible or extremely dangerous to examine this place, which is so curious for Naturalists. Many mining officers at *Joachimsthal* have since attempted to doubt whether these pretended antediluvian wood-like blocks ever have been real wood. They have considered them as a fibrous and black variety of the grey comb-rock, which they supposed generally to rise from this place, and thence to diverge in the several ramifications, which cross the mountains at *Joachimsthal*. This last supposition cannot be admitted, as these combs are so very different in their direction and dipping. But even the first supposition is destitute of foundation, unless a man should allow to himself to conclude from the remarkable scarcity of petrifications, in the simpler or pretended primogenial mountains, that no such petrifications are to be found or to be admitted at all. A Naturalist cannot help wishing to see these old drifts and caverns cleared again, in order to take fuller information of this singular phænomenon; but hitherto no information is to be had except what  
may

may be gathered from the accounts of *Matthesius* and those fragments which are kept in several cabinets. Their similarity with other petrified wood, especially with beech-wood, is so striking, that even the very first sight of it keeps down any doubt which you might have entertained against it, except you should be inclined to look upon the petrified wood in general as *lusus naturæ*. I remember to have seen in Baron *Pabst von Ohayn's* collection at *Freyberg* some very unequivocal samples. It was impossible to mistake the wood fibres, the yearly annular circles, the ramification of the branches, their roundish form and the soft unpetrified bark, which some people have falsely supposed to be amianthine fossil cork (*suber montanum*.) I cannot say any thing of the leaves, since I never did see them; but for my part, I am perfectly convinced that it is really petrified wood, and that I may rather depend upon the evidence of my eyes than upon the objections of some wise pyrrhonists, who might consider even the petrified shells of calcareous strata as sports of nature.

Subterraneous caverns have not been found generally but in calcareous hills. However, I know by very good authority, that a cavern of a remarkable width has been discovered in these argillaceous metallic slate mountains at *Joachimsthal*, in the midst of solid rocks, and in a depth of



250 fathoms. It was hit in 1772 by the fifth drift, driven by the *Hoh-Tanner* company on the *Andreas Vein*. A short time before they had fine ore in the vein from an half inch to three inches thick ; but suddenly, when the miners worked a blasting hole in the hading, a violent stroke from under ground forced the bore from their hands, and a flood of water, spouting not only from the hole, but breaking forth from every rock fissure, overflowed the whole drift, and obliged the miners to fly. Soon after the water ceased to break in from the roof a head, but it continued violently to spout from the bore hole to a distance of three fathoms. The engine could not overcome this subterraneous inundation till a second wheel was set to work, and the drift was drained again, which facilitated the going on with the works, and the breaking into a cavern eleven fathoms length and nine fathoms wide. Its roof appeared foul and shattered ; its floor was craggy by large rock masses tumbled from above ; and it was still filled with water, which made it impossible then to explore its depth. The sixth drift or level of the works has since been extended and driven towards the same place ; however, its depth or bottom is still unexplored.

Having giving the names of the several patentee-companies, and of the several fields which they are

are working, I shall here take notice of the veins, which fall within the extent of their works.

The field of *Hubert* is crossed by *Geyers*, *Paukners*, *Trinity's*, *Fundgrube*, *Baker*, *Gesbieber*, and *Anna* veins.

*Unity* works on *Andreas*, *Gesbieber*, *Cow vein*, *Seegen Gottes*, *Fundgrube*, *Backer*, *Hillebrand* and *Rose from Jericho*.

*Hobe Tann* works on *Geyer*, *Seegen Gottes*, *Andreas*, *Rose from Jericho*, and *Elias*.

*Fridenfeldt* on *Cow vein*, *Rose from Jericho*, *Schweitzer*, *Christopher*, *Joseph*, and several crossing morning veins.

The field of *Sächsisch-Edelleuth-Stolln* (or the *Saxonian* gentlemens gallery) is separated from the former fields, and situated in an argillaceous slate-hill, called the *Dirnberg*, which is independent of, and divided by a valley from the other metallic mountains. It is the highest top to the east of *Joachimsthal*; has its own veins, which seem to have no connexion with those in the metallic mountains. Being emptied towards the day, the works are driven already above 100 fathoms below the level of the valley. Its veins are likewise divided into eastern and northern veins.

The *Northern* or *Midnight Veins* are,

1. *S. Thomas*; runs in hour ten three lines, dips in fifty degrees to the east. It has two ramifications,  
which



which turn deaf where they unite. The vein-rock is white calcareous spar, red hornstone (*petrosilex*) and blende.

2. *Margaretha Vein* runs in hour eleven six lines; and spreads in two ramifications. They are metallic as far as they are yet pursued. The vein-rock is clay, and argillaceous slate sprinkled with pyrites.

3. *Hulf-Gottes-Vein* runs in hour eleven five lines; dips in seventy-five degrees, and spreads its fissures and ramifications in the hading, which from twenty to twenty fathoms unite again with the main vein. The ramifications separating from it make it deaf, carrying the ore along with them in the hading; but uniting again with it they make it quick and fair again. This seems rather to indicate two veins constantly and alternately separating and uniting. The vein-rock is argillaceous slate, clay, pitch-blende or black jack.

4. *Wolfs-Vein* runs in hour nine and three lines; dips in seventy-five degrees; is never quick but in crosses.

5. *Daniel* runs in hour nine and five lines. Is worked out.

6. *Newheusler* runs in hour ten, is worked out likewise.

7. *Zeitler* runs in hour twelve, dips in eighty degrees.

The

The *Morning Veins* cross the above northern ones, and are, 1. *Reichs Stollner Vein* running in hour five dipping in seventy-five degrees. 2. *King Saul* running in four and five, dipping in eighty-five degrees; both having in former times produced very rich ores, and are on that account worked out.

I shall only take notice here of the most remarkable ores found in these several veins at *Joachimsthal*, as Baron *Born*, in the printed account of his cabinet, has accurately described all their varieties, and the vein-rocks in which they are contained. But previously I am to observe, that all the ores of these veins are destitute of visible coverings, nay that often they appear sprinkled in the hading and hanging rocks, though the veins in themselves be not immediately grown to the rocks, but rather separated from them by thin argillaceous joints. To save the ore which is sprinkled in the rock sides of the vein, they are cut down on both sides of the vein one foot thickness, and delivered to the wash-works.

The most remarkable ores at *Joachimsthal* are as follows :

1. *Native silver* in different vein-rocks; in *Skard Cobolt* (*Scherben-Cobolt*) and on the black wacke it appears in capillary forms, and is called then *Brush-ore*. Native silver has been found in  
*Geshuber,*



*Gesbuber*, *Schweitzer*, and *Cow-vein*; though more common on these veins it has never been plenty.

2. *Glass-ore* is the richest ore at *Joachimsthal*; one hundred weight is commonly valued at 180 marks of silver. They melt it in lead in order to part it. It is in undetermined, crystalline, and grape-like forms, and has been found in former times on *Cow-vein*, *Rose from Jericho*, and *Schweitzer*, in so large lumps and masses, that small pyramids, statues, and many ornamental toys, have been carved of it, as appears from the accounts given by *Matthesius*, and from the many curiosities of that kind kept in the electoral cabinet at *Dresden*. Large crystalline pieces of glass-ore, found in former times, are kept for sale in the archives at *Joachimsthal*.

3. *Red silver-ore* found, in undetermined and in crystallized forms, is found on *Andreas*, *Geyer*, and *Backers-Veins*, in arsenical cobalt; in *Trinity* its matrix is arsenical pyrites; in *Gesbuber* it is red hornstone (*petrosilex*) and on *Rose from Jericho* it is rose-formed lamellous calcareous spar. This last variety, which is at present very scarce, is in respect of its singular beauty preferable to any other. The crystalline, ruby coloured, and pellucid red ore sticks on, and often in the midst of the above lamellous rosy-spar, which on that accident resembles now and then to a rose or ranunculus, and has given the name of that flower

to

to the vein in which it is found. A connoisseur will, by the very colour of the red ore, guess the mines in which it is found. The *Bohemian* red ore is remarkably fine ruby coloured and pellucid; that from *Andreasberg* in the *Harz-forest*, is somewhat darker, on account of its stronger mixture with sulphur; and iron that from *Saxony* keeps the middle between these varieties. *Agricola*, in the tenth book *de Natura Fossilium*, is of opinion, that the red ore from *Joachimsthal* on the *Barbara vein* is auriferous; which by the assayers is denied. I had no leisure to try it myself.

4. *White silver-ore* is said to have been found in former times on *Andreas* and *Rose* from *Jericho* in pyrites.

5. *Lead-Glance*, containing some silver, found in former times on *Geyer*, and in 1730 on *Cow-vein*, in one foot thickness. Such poor ores are generally scarce in the veins of finer ones.

6. *Yellow copper-ore* and pyrites, said to have been found in *Seegen Gottes*.

7. *Cobolt* in different argentiferous varieties occurs with several silver ores in the *Gesbuber*, *Hillebrandt*, *Rose* from *Jericho*, *Schweitzer*, *S. Esprit*, *Emperor Joseph*, and other veins. The pure cobolt, destitute of silver, is stampd and sold afterwards to several cobolt-manufactories in *Bohemia* and the *Empire*. A hundred weight sells from

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thirteen



thirteen to forty-five florins. In former times, the demands of that commodity being then less, they produced in the whole Kingdom not above 200,000 pounds; at present they produce about 1,000,000 of pounds. In the most ancient times cobolt-ores were by ignorance thrown amongst the rubbish; for this reason the bing-places at *Joachimsthal* are searched over at present, and some wash-works after the *Hungarian* principles are to be set up. The greater part of the *Bohemian* cobolt is exported to *Holland*. Though the *Bohemian* ores are as good as the *Saxonian* ones, the preparation of the smalte is not brought hitherto in *Bohemia* to the same mechanical perfection as in *Saxony*, where the manufacturers are never at a loss to work exactly the samples demanded. This seems owing to an imperfect separation of the ores, and to some ignorance of their nature and manipulation.

8. *Pitch Blende*, containing sometimes three marks of silver, said to have been found in 1772 on *Geyer's vein*, occurs in some other mines.

9. *Arsenical ore*, mispickel, now and then with some orpiment found with the cobolt and silver ores. In the old works on the *Hubert-vein* a white arsenical calx drips and coagulates into stalactites.

10. *Cinnabar-ore*, according to *Matthesius* and *Albinus*, formerly found in *Dorothea-vein* in the *Skottenberg* at *Joachimsthal*.

The

The hardness and solidity of the argillaceous slate or of the mountain rock is a great advantage to the works, since in most places they want no timber.

The engines are built according to the principles of those which are used at *Shemniz*, and which have been described by Mr. *Poda*. The same is to be said of their washing and stamping mills.

The history and the former riches of the mines at *Joachimsthal* have been described by Mr. *Peithner*, in the second volume of the *New Physical Amusements*, published at *Prague* in 1771 in Octavo.

*Aberdam two hours way distant from  
Joachimsthal.*

THE mines lie on the limits of the deeper granite and the incumbent argillaceous slate, and afford an easy opportunity to be convinced of the granites being under the slate.

Some veins at this place run in grey micaceous slate, and contain silver and cobalt-ores; some in reddish or alternating grey granite, which here, as commonly in *Bohemia* and *Saxonia*, contains tin ore, though some tin-veins are observed likewise to be in argillaceous slate.



*Eva's Apple-tree* and *Jerome* are the chief silver-mines at *Aberdam*. These veins are at a depth of sixty fathoms, and by uniting with red porphyry veins become remarkably richer. I have seen native silver, in wires and in capillary forms, in yellow, brown and black horn-stone (*petrosilex*) with glass-ore; and hair silver in cobalt, both found in *Eva's Apple-tree*.

The *Morrice-mine* and some others are in granite, and are worked for tin.

*Matthesius* and *Albinus* tell that a transparent cinnabar-ore has been found formerly in *S. Lawrence* at *Aberdam*.

### Platte in the Circle of Saaz.

HERE are three different sorts of mines, silver, iron and tin-mines.

*Zwittermill* is a high mountain two hours distant from *Platte*.

Its eastern part consists of ash-grey micaceous slate or a species of gneiss, in which *Trinity silver-mine* is working. Its western part consists of solid compact hornslate or a mixture of quartz and mica, thoroughly mixed and penetrated with some iron. This hornslate is extremely hard and sonorous as metal. It belongs to the *Corneus Wallerii*. They dig it in a quarry, cut it into the form

form of pestels, and use it hereabout, and as far as *Johan Georgenstadt in Saxonia*, instead of iron ones, as being less expensive and less obnoxious to the tin-ore. For this reason this hornstone is called hereabout *poch wacke*. *S. John Baptist's* vein crosses this rock, and consisting of blackish, more or less micaceous deaf clay slate, its working has been given up. The hornstone in the hanging and hading of this vein is softer than the common *poch wacke*, grey coloured, mixed with mica, and similar to the grey gneiss on the eastern side of this mountain; whence it appears that this hornstone is but a variety of the eastern and general rock of the *Zwitter-mill*.

In *Trinity* mine on the eastern part of this mountain two veins are working, called *Heavenly Blessing* and *Divine Providence*. To the west they are compressed by the hornstone; but they may very likely in a greater depth unite and fall in together by their dipping, and then prove quick and metallic. It is observed in this mountain, that the silver morning-veins, running in hour 7 or  $7\frac{1}{2}$  are quick and metallic if standing or vertical; if they dip less than 45 degrees, that is flat or soaring, they are deaf.

2. *Irrgang* or *Labyrinth* is a large iron vein, which all along its run in hour nine, line four, for a space of about three *German* miles, as far as *Annaberg in Saxonia*, is worked by several com-



panies. Each of these companies gives to its field and part of the vein a particular name. For example, *Maria Hulf mine* near *Platte* calls it *Hilf Gottes-vein*. Here the hanging is granite, and the hanging slate; and it has been observed to be richest where running between these rocks. Commonly it runs in granite, which often contains spherulites; and it gets a hanging of slate in those places where it runs into the incumbent slate. They told me, that this granite-rock contains some wedges of basaltes. Crossing fossil and argillaceous veins force this iron vein into a different direction; but constantly it returns to its rule and main direction. It is about four fathoms wide, and yields the finest red button-ore and other argillaceous red iron-ore, which often appears in a thickness of one fathom. Now and then brownstone or manganese is found with the button-ore, and they use it as a flux.

The *Tin-mines* near *Platte* are all of them in granite.

*S. Conrad* is the chief of all, and works the following veins:

1. *S. Christopher's vein*, running in hour 11, points 6, dipping in 72 degrees.

2. *Fresh-fortune's vein*, running in hour 11  $\frac{1}{2}$ , dipping in 82 degrees.

3. *Conrads-vein*, running between hour 8 and 9, and makes a cross with the two former. It dips in 82 degrees.

4. *Christ*

4. *Christ birth's vein* runs in hour 3.

5. *Matthiew'i vein*. They basset generally out with tin-stone, which formerly has been washed and thus furnished an opportunity for discovering the veins. The rock, in which they run, is reddish and grey-granite, sometimes greenish. Their vein rock is loose granite with parallel layers or stripes of zwitter; which diverging from the vein make it extremely thin. Generally it is from one to four fathoms wide; and so it was about the middle of its depth. The deepest pit is eighty fathoms; the vein still quick. White yellow clay or lithomarga, blackish mica, and fine pointed black wolfram or pyrites are found with the tin-zwitter. The wolfram is here in deaf veins, the constant fore runner of tin. The crossings of the veins, and of the smaller vertical or flat fissures running in hour six improve these veins in general.

### Gottes Gab in the Circle of Saaz.

IN this place there is at present no mine working except in the *Kass*, a mountain consisting of micaceous and quartzous clay-slate. They dig here in several pits, such as *Jobn in the desert*, *Tubal-Cain*, iron ore, good loadstones, and rich but irony tin-zwitter. Accidentally they meet



likewise with copper and silver-ore; nay there have been found samples of silver, copper, iron and tin sticking in the same matrix.

The miners suppose that an iron-flat or bed is incumbent here on a tin-flat or tin-stratum; but that is inconsistent with the height and nature of the mountain, which is a simple or true gang-or primitive mountain. Several veins, vertical as well as flat ones, cross it. The latter carry iron and tin, and being flat and soaring have been by the miners mistaken for flats. The vertical veins strike them dead; and they yield less tin as soon as they are united with silver fissures; this seems to be owing to the same cause, which in the *Saxonian* metallic mountains produced silver in arsenical veins (and such are the tin-veins) wherever they are crossed by iron fissures. Instead of cobalt, mispikkel, tin and other arsenical ore, they yield then silver-ore. Though such particular observations are far from establishing general principles, and the alchymistical conclusion, that iron and arsenic produce silver, might prove too bold and too rash perhaps; I am however of opinion, that such observations if made with precision and veracity, are extremely interesting and useful, since they establish not only rules for particular mountains, veins and mines, but may in time lead to a nearer knowledge of the hitherto too mysterious chemical preparations of nature.

I have

I have said that in the *Kaff-mountain* iron and tin is dug in the same pit and in the same vein. The iron here generally appears in its upper part; the tin, which is here extremely irony, constantly appears at a greater depth; and it would be worth while to examine whether silver-ore might not be found in a still greater depth, which might be easily done by a gallery. My conjecture is supported by a general observation in the neighbouring *Saxonian* rich silver mines. The same vein contains there under the turf iron, in a middle depth tin, and at the greatest depth silver; and this seems to be owing to the same cause, which in any point of these veins, if arsenical, has produced silver whenever, as I told before, an irony vein comes across or unites with them. Having already declared my opinion on the importance of this observation and its consequences, and being far from inclining to alchymistical fancies, I hope not to be asked for a natural solution of this phænomenon. I declare freely to be as ignorant of the causes as I should like to know them; what I know of the matter is, that this phænomenon is fact in the *Saxonian* metallic mountains. It is not I alone who have been convinced of it by several observations; some of the most learned miners can attest it, and have convinced me of it by many examples. Nay in *Saxony* they make use of this and other such observations, and apply them



them with success to a scientific and practical working of their mines; and even the annalists of the *Saxonian* mining places, but still more so the ancient records, prove that several *Saxonian* mines, at present producing silver, yielded in former times, and in their upper drifts, good tin-and iron-ore. Mr. *Peithner*, who before his present preferment to the character of counsellor, taught at *Prague* the science of mines, has found the same observation supported by several corresponding ones in *Bohemia*. I have perused some parts of his lectures, as penned down by one of his disciples, and in these I find the following passage: “ Some of our *Bohemian* mountains, “ such as those at *Platten*, *Neudeck*, *Gottes Gab*, and “ above the *golden-top*, near the new road to *Berlin-* “ *ger*, and some others, consist in their upper parts “ and drifts of iron flats or beds,” (which as I have already noticed is a mistake of flat and soaring veins) “ but in a greater depth they are fol- “ lowed by rich tin, nay even by silver-ore.”

I return to the mines in *Kaff*. Pyrites here quickens the tin-ore. The tin-ore, after a previous roasting, is pounded and washed on hearths, in which operation they make use of the loadstone in order to separate the iron. Though all the iron particles cannot be drawn off by the loadstone, they are however raised by it, and the easier washed down.

Formerly

Formerly there have been near *Gottes Gab* silver mines, which are said to have produced a dark red silver-ore, hereabout called native brown-ore.

*Bleystadt, in the Circle of Saaz.*

THE mountains consist of grey micaceous quartzous and argillaceous slate, which in a mine called *Heerzug* contains red garnets. The richest veins run from the west; the northerly veins are deaf and crush the former. The rock filling the western or eastern veins consists of quartz, which they call *gneiss*, and appears under a sound and compact or a loose and a farinaceous form.

Their dipping is generally vertical, and their width is from three to eight feet. They are steady to a depth of 160 fathoms, till the quartz turns deaf and unmetallic. The ore is coarse glance, and now and then white lead-ore and brown and reddish lead-clay. Formerly there was likewise green lead-ore. The glance containing scarce any silver, they pound and sell it either as lead to the furnaces at *Joachimsthal*, or to the potters for glazing.

Schlackenwald,



Schlackenwald, *in the Circle of Saaz.*

THE country is rather gently ascending than mountainous; accordingly they till and plow the soil which covers the deeper rocks. These consist of a mixture of quartz, glimmer, and white clay, which splits into lamellæ, and forms gneifs, or a continuation and variety of the *Bohemian* argillaceous metallic mountains. They have here three different sorts of veins.

1. *Lead-veins* with silver; and particularly a quartz vein in the Emperor *Joseph's* gallery, running in hour eight.

2. *Tin veins*, such as those in the cross mine, which produces wolfram, copper pyrites, tin ore, and tin zwitter in quartz.

3. *Tin stocks*. In some mineralogical accounts, the name of stock-works is too often misapplied to the uniting of several veins in the same run, or to the larger bellies of single veins. In either of these cases there is no reason, why the name of vein should be given up for that of a stock-work. I understand by *stock-work*, that native place of metals, which without any regular or determined run to any certain point or line of the compass, and without any determined dipping

ping, appears rather as a large conical body of rocks, sunk or inserted in the midst of a mountain. Such a cone or lump consists either of pure ore or of a rock, which is more or less impregnated and penetrated with metallic particles, and is constantly of a different kind than the surrounding or including rock. The whole stock is included within a curve line, which may be either an oval or a circular one. These circular out-lines either unite as commonly in the depth or they diverge. In the first case the stock has the form of an inverted cone; in this it hath the form of a truncated and standing cone. Three such stocks have been hitherto observed at *Schlackenwald*, 1. The *Royal Huber*, which is the largest, and still working. 2. The *Stock-shaft*, smaller and worked out. 3. A *Stock* not yet examined, but reputed to be of the same circumference as the second. Their natural condition being the same, as far as hitherto observed, I shall confine myself to the description of the *Royal Huber*.

The rock which surrounds it, or in which it is standing, is *gneiss*. The stock itself consists of granite, or a mixture of quartz, feldspath and mica-grains and lamellæ, more or less penetrated and sprinkled with tin-ore.

The feldspath is reddish or grey; but often in its place appears a white and greenish clay, which probably



probably might have turned into feldspath, as a decay or mouldering in the midst of the rock and under ground cannot be properly supposed. This last variety of granite, which is commonly the least rich of tin, is at *Schlackenwald* called *grit* (*greifs*) and its constituent parts, quartz, mica and clay seem to indicate, that it is but a variety of the gneifs, which surrounds the stock. In a mineralogical respect that assertion is pretty true; and the difference of the rocks being lamellous and of the grits appearing in a compact form, is of no importance. However, this difference is very remarkable and interesting in respect of their origin, antiquity and situation.

This grit-stone consists of grains and lamellæ, ferruminated together as the pebbles in a pudding stone. Whatever be its origin, it is in respect of the time and the manner, in which it happened, of course different from that revolution, in which similar constituent parts joined into an uniform, not granulated more compact rock, which is lamellous, and goes under the name of gneifs. Moreover it breaks in with the granite of the stock, without any remarkable separation or bedding; it never occurs in the including gneifs. Accordingly it is a variety of the granite, and is produced with it in the stock, in the same moment and by the same revolution.

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The granite of this stock is comparatively with the common metallic mountains to be considered as the vein; the surrounding gneiss is in the same respect to be compared with country rock. But here the question arises: whether this stock, like other veins and fissures, be produced after, and in its præ-existing mountain-rock? Or whether this granite-stock may be considered as a top or summit of the ancient primitive and deeper granite, which was afterwards surrounded, inclosed and covered by the more modern gneiss? Being convinced by many facts that granite is a more ancient and deeper rock than argillaceous slate, gneiss and other such varieties; having moreover seen many instances of the granites high and bare appearing through and above the more modern and incumbent rocks, I am rather inclined to this last opinion.

1. Because the common theory of the origin of veins by fissures or cracks produced in the mountain-rocks, when first they began to dry, does not account for round conical holes in the mountain-rocks, of such extent and regular form as the stocks under consideration.

2. Because even allowing such conical holes there remains the difficulty, how they might have been afterwards filled up with granite, which commonly



commonly is not found as vein-rock, except in its own fissures.

However, to wave the charge of being too much prejudiced for my hypothesis, I leave my conjectures of the origin and antiquity of this granite-stock and its surrounding gneiss-mountain, to the consideration of the intelligent reader. Nay, in support of those, who might be inclined to consider this granite stock as being of more modern date and produced in the more ancient gneiss, I will candidly relate, that the *Royal Huber Granite-stock* in its upper part is 100, but in the depth only 92 fathoms diameter, having the form of an inverted cone, and being for that the more resembling to the metallic veins, which diminish to the depth, and at last disappear entirely.

But there is besides a third possibility ; that of the granite stocks and gneiss-rocks being produced at the same time. Of all the before-mentioned this is indeed the least probable.

Whatever hypothesis my readers should have a mind to, they will observe that no conclusion can be drawn from them against the general observation, that the granite in the largest and highest *European* mountains is more ancient than argillaceous slate and gneiss ; and that these are incumbent on granite, as limestone and other modern beds are accumulated on them. Though by my  
own

own, and so many other observations, I am convinced of that, I cannot deny to nature the power of producing under proper circumstances the same species of granite or rock, which it produced in former times, either by water or by fire, as appears by some lava's which exactly resemble the graniello's. It is obvious that I meant not to speak of these supposed modern granites, but of the ancient ones, in which we can be the less mistaken, as nature in its present quiet course, and without some new and great revolution in our globe, is not likely to produce any remarkable granite rocks, or any far-stretching, high-towering chain of such mountains. The argillaceous slate of the chief, middle and richer, metallic mountains in *Europe* is, in a mineralogical respect, the same as that slate, which is bedded in the more modern mountains; nay which is every day produced by the ooze of every muddy lake; however, it would be extremely wrong to confound them in a Natural History of the Earth, in the same manner as they are confounded in a Syllabus of Mineralogy. Similar beds of clay or other stratified stones, or different only by accidental circumstances, such as that of colour or hardness, or mixture of iron, lime or phlogiston, are very often found in different depths and separated by other strata. A mere mineralogist or collector of fossils would

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rank the produce of these different beds in the same class, nor think of any difference; but the historian of subterranean geography cannot fail to observe their differences in respect of their antiquity, origin, relation to other beds, metallic contents, and influence on the crossing veins. The fine-grained limestone of the *Alps*, the scaly or saline limestone, the calcareous tophus or travertine, the limestone incumbent on coals, and finally that species, which we see every day on the *Dutch* shore, produced by sea shells, are lime, nay some of these different species agree in the manner of their origin; though in general they are different in this and in many other respects. A common systematical collector will unconcernedly break the flints from their chalk-matrix, in which they are found in *France*, in *England*, and in *Stevens-Klint* on *Seeland*, and most systematically rank the flints with the other silices, and the chalk with the calcareous earths; but a scientific naturalist draws from these native places, and other concomitant circumstances, conclusions on the origin of the flints. The former examples illustrate what I have said of the granite and its varieties; and the latter demonstrate the necessity and use of a nice observation of the different native places of fossils.

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I return to *Schlackenwald*. The mixture of the granite is not uniform throughout the mass of the whole stock. Sometimes large stripes of pure quartz are contained in it, and these are remarkably rich of tin-ore, with blue and green fluors, of wolfram, some copper-pyrites and black-lead (*molybdæna*.) In other places the mica is accumulated in large laminæ; in others prevails the feldspath, or, instead of that, a white fat clay. Though the whole stock be throughout sprinkled with tin-ore, it is however more frequent and more accumulated in the parallel stripes, which cross the finer grey or reddish granite.

Some deaf fissures or veins cross the stock commonly in hour three. The ancients made use of them in their works, especially for firing the ore. One vein, called the *Tsberpermaas-Vein*, crosses our granite stock in hour twelve, and contains tin-ore, pyrites and wolfram in quartz. I am ignorant, whether these veins have their constant run beyond the granite-stock in the gneiss, a circumstance which is observed in the tin-stock at *Geyer* in *Saxony*, and might be supposed perhaps in this, as they are found agreeing in so many other circumstances. I am equally ignorant whether this granite-stock, as that at *Geyer*, have a skirt or inclosure (*stockscheider*) which in that place consists of feldspath, sometimes mixed with



quartz, mica or clay. The tin-stock at *Altenberg* in *Saxony* is of a different nature, since inclosed in granite, and consisting of a variety of granite, in which the quartzous particles are prevailing.

The mines at *Schlackenwald* are said to have been working above 530 years. The *Royal Huber* was formerly held by grant by several companies, who worked this stock in common with the Empress-queen ; but hence arose very irregular works, which in this place are of old standing, since the upper fields or levels, having been worked out without any respect to after-times gave way before the year 1580, and caused a large gaping fissure, which is still to be seen. However, they went on again with the same irregularity in the under levels, which are said to be above 100 fathoms under ground. The consequence is, that even at present the works cannot be safely examined, and that any jumping on the turf above the works makes the whole ground tremble and shake. Some time after the ocular examination of these mines by Baron *Mitrofsky*, which happened in the year 1743, her Royal and Imperial Majesty has recalled and redeemed the grants, but to no great advantage, since after the irregular ravages of the old man, which have crippled the whole stock, it is almost impossible to introduce any regular work besides, and the richer and larger tin-

tin-ore crystals of former times seem to be gone. Formerly they had here that scarce species of ore, which is known under the name of white tin-ore.

*Beyer in otiiis metallicis*, Part. III. p. 169, has given an account of the preparing, ustulating, washing and smelting of these and other tin-ores.

To encourage and to facilitate the *Bohemian* tin-mines in general, her Majesty has ordered her mineral trade commission at *Vienna* to buy the *Bohemian* tin at a certain fixed price.

The tin-ores of *Schlackenwald*, *Platte*, *Gottesgab* and of many *Bohemian* wash-works, were formerly supposed to be auriferous, and to contain some silver. But modern assays have proved the contrary.

### Schonfeld, near Schlackenwald.

THE tin mines in this place are the most ancient in *Bohemia*. Of the former silver mines nothing is remaining but ancient records. The *Simon Judas* and the *Cross* mine have been the richest tin-mines, and were worked on veins which ran in *gneiss*. The white tin-ore, which



*Cronstedt*, §. 2. 209, has called *ferrum calciforme terra quadam incognita intime mixtum*, was found in these mines. It offers either compact in indeterminate forms, in which case it resembles to ponderous white or greenish and fat quartz, or in white or yellow splendid crystallisations.

*Græslitz, in the Circle of Saaz.*

**H**AS yellow and greenish copper-pyrites, with green and brown copper ochres in argillaceous and quartzous slate. In the smelting of these pyrites nothing is remarkable, except that they make use of white fluor, fetched from *Saxony*, and that to some soft pyrites they mix limestone.

*Mies, in the Circle of Pilsen.*

**T**HE mountains consist of grey micaceous and argillaceous slate, sometimes mixed with quartz. The veins are generally quartz, which now and then is crystallised. In a species of these crystallisations I observed the same parallel incisions

cisions, which are a character of the crystallisations from *Hodriz* near *Škernitz* in *Lower Hungary*. The ore is lead glance, which per hundred weight yields from two to four ounces of silver, and towards forty pounds of lead. Yellowish green hexagonal prismatic lead spar has been found in former times. The works are in great decline, and have ever been very ill contrived, which makes their examination not only difficult but dangerous too.

*The coal work near Wilkischen in the Circle  
of Pilsen.*

IT is but of late that in this place a gallery has been driven into a coal-bed, which bassets out; and they have but just begun to sink a shaft upon it. If I were only to write for those who in the art and science of the mines see and conceive no further entertainment than as far as they have a prospect of clear gain before them; and if I were not convinced too, that exact mineralogical observations, even of poor mines, may prove very useful for richer ones, I might have very justly suppressed what I shall have to say of this inconsiderable coal-work and its situation. But as those gentlemen will not possibly loose their time with my

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performances,



performances, I shall rather freely submit my observations to the judgment of the few learned connoisseurs.

The mountains, which to the west divide *Bohemia* from the *Upper-Palatinate* and *Bavaria*, consist of granite and of several varieties of argillaceous slate. The granite of the highest mountains hereabout contains large and thick black spherl-crystals. In my descriptions of the mines at *Catharinaberg* I have given already some account of the rocks of these mountains, which connect with the Circle of *Pilsen*, and to the south run into the Circle of *Prackin*, and to the north into that of *Saaz*. In order to determine the situation of the coal-bed at *Wilkischen*, I am to fix upon a point of this ridge of mountains, and that shall be at *Kladraw*, one hour's way distant from *Wilkischen*.

The mountains in this place consist of pure sometimes micaceous and more or less quartzous dark grey or blueish argillaceous slate. \*

\* If a great quantity of quartz be closely blended and connected with argillaceous slate, it proves very hard and longitudinally fibrous in the fractures; that is to say, it changes into true *horn slate*. *Corneus Fissilis Wallerii Mineral*, Ed. 2. p. 358. 2. I have been convinced at *Kladraw* of this degeneration. Pure argillaceous slate is commonly crossed by quartz veins. Horn slate has no such veins, but instead of them quartz has internally and equally connected itself with the clay and its produce the mica. It is found here in  
the

On the road between *Kladraw* and *Haide*, and towards *Pilsen* fragments of this slate are found, some of them regular cubes, others in the form of oblique or rhomboidal pyramidal columns, from some inches to one foot in height; their form as the crystal, n. 8. tab. I. in *Linne's Systema Naturæ*, tom. III. In the granite mountains, near *Kladraw*, I have found similar rhomboidal and pyramidal columns of grey and reddish granite. Their form is constant and regular; in

the same horizontal or soaring situation as the common pure argillaceous slate; accordingly it is not constantly in a vertical position, as at *Edelfors* or in other metallic mountains; nor does it appear in the form of waves. It may be doubted therefore with great propriety, whether that vertical position hath been its natural position from its very beginning. Moreover the position, which may be accidental, does not determine the species; the less so as even the purest argillaceous slate, nay many other modern stratified stone beds appear not only in horizontal and soaring, but likewise in many other, and even in vertical positions. All these circumstances, together with the chemical assays, prove it to be argillaceous (*Wallerii Mineralogy*. ed. 2, p. 355, 358, 359, and 364.) and convince me, that it should not be considered as a genus, but that it might be very justly ranked with the common argillaceous slate (*Schistus Wallerii*.) However, as it is a variety, I do not controvert its proper name and classification in the Mineralogical Systems; but in respect to physical geography it should ever be separated from the argillaceous slate.

some



some of them the feldspath, in some others the quartz is decayed into farinaceous clay.

But a third species of columns of the same form is to be found about *Kladraw*; and this consists of a variety of the dark grey argillaceous slate, which seems to be an intermediate substance between argillaceous slate and granite. Its substance is darkgrey, blackish and fine micaceous slate; but it is mixed with parallelopiped spots of white and lamellous feldspath, which exposed to the air turn milky and opaque. By this accident it resembles to porphyry or to a variety of granite. Near *Plan* red garnets are found in it, which proves its being a variety of argillaceous slate, because the *Bohemian* garnets are commonly in micaceous quartzous clay slate. Perhaps the rock, I am speaking of, is breaking in the limits where slate and granite border together. It is in my opinion a remarkable phænomenon, that this variety of argillaceous slate with spots of feldspath, nay even the pure argillaceous slate and granite are found in these parts in constant determined and regular columnar forms; and as they are found so in their natural situation in the mountains, it appears clearly that these rocks in their former state of fluidity had a natural tendency to a regular form whatever be the cause of it:

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The regularity of their faces and angles would induce me to consider their forms as crystallisations; but as commonly the name of crystallisations is given only to regular aggregations of dissolved saline and metallic bodies, I leave to my readers the liberty to look out for a better name. It is fact, that these rocks split and break with as much regularity as possibly may be produced by any crystallisation. How it happens, that so few granite and slate-rocks, and those but in certain places, are endowed with that quality, I am at a loss to account for. ||

In the neighbourhood of *Kladraw* is another variety of argillaceous slate. It is closely mixed with quartz and mica; is extremely shivery and a true table-slate (*ardefia*) for which reason they break and use it instead of tiles. The convent at *Kladraw* is covered with it; and I suppose it is a fair conclusion that this table-slate (*ardefia*) is not constantly found in modern or flat-mountains (*flozberge*.)

|| Let us fairly confess that we are equally ignorant of the natural causes of the saline and metallic crystallisations; and that besides the above-mentioned rocks and stones there are many more, which break into regular forms, though these have not been hitherto properly attended to by our Mineralogists. I gave a hint of that kind in the first *Latin* edition of my *System of the Earth*, p. 11, 12, 13.

The



The coal-work at *Wilkiſhen* is but one hour's way diſtant from *Kladraw*, and the road is thence conſtantly deſcending. In the adjacent fields, and ſcarce a gunſhot diſtant, many grey granite blocks appear above the vegetable mould. I could not diſtinguiſh whether theſe blocks were detached pieces, or parts of the granite-rocks under ground; but it is fact, that the coal-bed, with its ſkirts of black and rotten ſlate, is but from three to fix fathom under the turf. Its roof or cover conſiſts of a mixture of white-grey clay, ſome quartz-grains and ſome flakes of argentine white mica; that is to ſay, it conſiſts of a looſe incoherent granite, which on that account rather deſerves the name of ſand, and in fact is called ſo by the workmen. The queſtion: whence it was produced? is eaſily answered by the above deſcription of the higher mountains near *Kladraw*; and that roof may juſtly be conſidered as grit and décays of the ſchiſtous and granite mountains, waſhed down and ſucceſſively accumulated upon the coal-bed. But what is the coal-bed in itſelf? I ſay, it is the continuation of the argillaceous ſlate at *Kladraw*, penetrated in this by petroleum; accordingly it is not, as commonly, a modern flat, accumulated on the primitive mountain rock at *Kladraw*, but it is  
a part

a part and a continuation of that very primitive mountain. §

Some of my readers will, I am confident, find this assertion at variance with the common opinion, according to which coal-beds are generally considered as constantly belonging to the modern accumulated flats (*flozberge*) and as never making part of the more simple ancient or primitive mountains; but as coals are argillaceous slate penetrated with petroleum, ¶ I see no reason why

§ Though the continual sloping descent of the primitive ground from *Kladraw* to *Wilkiſben* be favourable to this hypothesis, it wants nevertheless better evidence, as on that sloping primitive ground modern beds might have been accumulated by the same revolutions, which have accumulated so many others.

However it would be very unfair to deny the possibility and ingenuity of the hypothesis, stubbornly to assert with some Mineralogists against facts and reason, 1. that coalbeds are constantly to be considered as the remains of ancient forests, and 2. that they are constantly covered with and accumulated on modern strata. That assertion may be supported by partial and local observations; but they can never make good a general assertion as will appear in the sequel.

¶ Many coal-beds consist visibly of remains of trees, plants and forests, more or less bituminous, and more or less affected and changed by the situation in which ancient revolutions have left and brought them.

These are out of question here. Mr. *Ferber* might however have taken some notice of them, by telling, that besides these coal-beds, there are some others, which are undoubtedly consisting of bituminous argillaceous modern slate. It would not have hurt his hypothesis.

nature



nature should not saturate with the same substance any argillaceous slate, whether it be of an ancient or a more modern origin; and I am the more of this opinion, as we are far from being convinced that petroleum is only to be found in modern beds. The distinction between the modern flats and the pretended primitive mountains is less material than is commonly supposed. It merely relates to their different antiquity; for the argillaceous slate of the pretended primitive mountains is as well accumulated on granite as every other modern bed is accumulated either on granite or other rocks; and whether this accumulation arrived in the beginning of the world, or long after, is an object of mere conjecture. The different width of the strata is of no greater importance. The pretended primitive mountains are moreover called *Gang* or *Vein*-mountains, because metallic veins are generally found in them; and as these have been formerly working at *Kladraw* there is no doubt, that the mountains hereabout are justly to be considered as primitive or gang-mountains; However, this circumstance alone would not make good the assertion, since metallic veins are likewise found in modern stratified flats; for example the cobalt-work in *Saxe-Saalfeld*; the lead-works in *Derbyshire*, and in many other places; for hence it naturally follows, that the mountains

tains produced by water, or by aqueous solution, in respect of the different periods of their origin and accumulation, and on no other account, can be with propriety divided into old and modern ones, owing their origin to different degrees of relative antiquity. The *ancient-mountains* might, in comparison to the modern incumbent ones, and their greater variety of thin strata, be called with greater propriety *simple mountains*. Their denomination of primitive, original, or gang-mountains is by no means characteristic.

I am to obviate here an objection, which probably will be made to me by those who are acquainted with the country between *Kladraw* and *Wilkisben*, and between *Pilsen* and *Prague*. It is in general flat, and immediately behind *Kladraw* the mountains slope into a plain, which consists of clay and loam, and afterwards of coal, lime, and other deposited aqueous modern strata. Accordingly this whole tract of land seems to be covered by modern beds, beginning at *Wilkisben*. But I cannot allow that assertion in respect to the place I am treating of, since the coal-works at *Wilkisben* are not in the plain, but in the sloping of the higher ancient mountains. Besides, the coals are immediately under the turf, being covered only by loose grit and decays of the higher mountains, and destitute of any regular roof of  
lime



lime or marle. I had no opportunity to examine the coal-works at *Kottesbaw*, which are but one hour's ride distant; but I am assured for the rest that the whole tract of land hence to *Pilsen* and *Prague* is generally flat and stratified, containing some coal-beds near *Pilsen*, *Shabrach*, *Berawn*, and limestone beds at *Stiez*, which are covered by greyish yellow clay. Probably the brooks at *Pilsen* and *Berawn* were larger in former times, and may be supposed to have deposited these different beds. The ancient mountains behind *Kladraw* however, which consist of argillaceous slate and granite, continue uninterruptedly running under ground; for they appear above ground in several places between *Kladraw*, *Pilsen* and *Prague*. The grey granite-rocks appear on the road from *Kladraw* to *Pilsen*; and thence to *Prague* the argillaceous slate, which is either pure, or micaceous, or a horn-schistus. All this together coincides to shew that the coals at *Wilkishen* may belong to the more ancient mountains, which are found running under ground far beyond this place. Even so far as *Prague* are observed some schistous mountains, which rise high above the ground. The other mountains thereabout are calcareous, and contain petrifications; so that the common coal-beds at *Shabrach*, and the different strata of marle and clay, which are found between the prominent

ment rocks of argillaceous slate, may be justly ascribed to one or to different inundations. The grey-yellow vegetable mould between *Kladraw* and *Prague* is for the greater part owing to inundations; however it is partly produced by the decays of the argillaceous and micaceous slate-gneiss and hornstone-rocks, which appear above the ground; and this is evident from the mica flakes, which are found in it.

The conclusion, which I am to draw from this, is, that coals are not constantly found in the modern flats, but that ancient (pretended primitive) argillaceous slate is likewise now and then saturated and penetrated by petroleum. This may be probably observed in many other places. Should it not perhaps be the case of the coal-works in the high and shaggy mountains of the *Habichwald* near *Cassel* in *Hesse*? † There are several others, which

† For this I refer the reader to my late account of the *German* volcanos, by which it will appear, that this large and shaggy mountain is produced by many successive ancient volcanic eruptions, and cannot by any means be ranked among those ancient granite-or shistous-metallic-mountains, which Mr. *Ferber* is speaking of. However, as I have no objection against his hypothesis, and am rather inclined to agree with him, I shall listen to his call on the naturalists, and by laying down in a few words, what I know by my own observation



which I suspect to be of the same nature. However, I wish, that intelligent naturalists might examine this my adventurous opinion, compare it with nature, and confirm or refute it by exact observations. It is of some importance to the naturalist, nay even to the miner, since it accounts and will account not only for the horizontal and soaring, but likewise for the vertical situation of coals.

*Zinnwald*

tion of the coal-mine on the *Habichswald*, not only make a supplement to the above description, but likewise to Mr. *Ferber's* assertion.

On the highest summit of the *Habichswald*, which consists of alternating and various beds and rocks of volcanic ashes, lavas, cinders and tufo, accumulated on more ancient lime and sandstone, there is (besides a spacious plain behind the octogon,) towards *Hof*, a gently sloping ground, which falls or runs down into the *Druselthal*. In the midst of this ground rises a hill, which is called the *Zigenberg*, and is incumbent on the lower coal-bed, which has been worked in many directions, and as it should seem, surrounds it on every side.

The strata in this coal-mine are, 1. Immediately under the turf, black vegetable mould, mixed with decays of the surrounding volcanic hills, that is to say, with fragments of hard lava and tufo; three feet.

2. White fine quick sand, as found on the other side of the *Druselthal*, and the hill behind the *Pauls-harmitage*, under many tufo and lava beds, in an ancient pit and gallery, called the *silver-well*, and behind the *Sneckenberg* in a sand-pit immediately surrounded with volcanic materials, but not capped with them. One fathom three feet.

3. White

### Zinnwald in the Circle of Leitmeriz.

THE mines in this place are but slowly working, if working at all. The country or the mountain-rock is granite of a different mixture. Some large *soaring-veins*, which very improperly

3. White fine clay, as found likewise under the above sand pit; and under a stratum of basalt behind the great water spout in the garden at *Weissenstine*; three fathoms.

Digging in this clay bed to the depth of three fathoms, it begins first to turn grey by stripes and afterwards entirely black, till it degenerates into coals; which is visibly owing to its greater or lesser saturation with petroleum.

4. Coals, having in this mine no roof, as being immediately connected with their substantial earth, the above clay; three fathom three feet.

The clay penetrated with petroleum, or the uppermost imperfect coal, is in some places loose, and a species of blackish or brownish rubble or rotten-stone, which being an excellent brown or blackish painters clay, was formerly sold under the name of *Painters clay* from *Cassel*, till the painter *Huchfeld* died who dealt in it, and had kept its native place a secret. I have found it again, not only in the coal-mine, but likewise immediately under the above sand pit behind the *Snekenberg*, whence the painter *Huchfeld* is said to have dug it.

Towards the sole the coals turn harder and richer, being then more bituminous and more like the *Scotch* coal; which again proves the former presence of fluid petroleum.



improperly they call flats run in it, and these are variously cut off, compressed and altered in their direction by other vertical ones; in which case they are pursued and found out again by the small metallic or argillaceous joints, which to the *German* miners are known under the name of *Schleppungen*,

5. The sole of the coals is white sand rock, extremely hard, and striking fire with steel. As hitherto no pit has been sunk through this rock, I cannot tell on what ground it is incumbent, whether on volcanic masses, which in respect of the high situation of the coal-mine on the summit of the *Habichswald* is probable, or on limestone, which seems to be the case in respect of the similar sandstone rocks, found on the other side of the *Druseltal* near the castle of *Weissenstein*, which is in a lower situation than any volcanic stratum of the *Habichswald*.

From these facts I draw the conclusions, 1. that coals are not constantly found in any regular order of successive strata, nor constantly under a roof; 2. that being in this place visibly produced from clay, saturated by petroleum, they may be found in any place or situation where clay or argillaceous slate is to be met with, in ancient simple or modern stratified mountains, as well as on and in volcanic mountains; and 3. that henceforth coals will not be considered as constantly produced from trees, plants and forests, buried by inundations, though many coal-mines have had such an origin.

I cannot conclude this account without taking notice of some spungy coals, which occur now and then in the coal-bed.

*Schleppungen*, and have been described by Baron Swab in the *Swedish Transactions*, or in his account of the gold-veins at *Edelfors*. The rock of the soaring veins consists of various mixed granite, quartz partly crystallised, tin ore, blue, green and yellow fluor, pyrites and verdegrease. They appear often on both sides inclosed by *saalbands* or skirts of lamellated cat-gold of some inches thickness.

bed on the *Habichwald*. They are found by nodules within the found coal-bed; are extremely light, and resemble the scorified spungy lava's, found near the octogon on the *Habichwald*. They cannot possibly be considered as cinders or as coals consumed by fire; since there is no reason why they should have been burnt out, and why their heat or fire should not have caught the combustible matrix of found coals, in which they are contained.

If I were allowed to suppose that the clay-bed on the *Habichwald* was produced, as those in the *Solfatara*, from volcanic ashes, changed by sulphurous acid into clay, there would be less difficulty to account for these spungy honey-combed coals; since then they might be justly considered as spungy volcanic cinders or consumed lavas, together with the volcanic ashes, first changed into clay by sulphurous acid, and afterwards changed into coals by fluid petroleum. Though I am inclined to think so, I leave it however to the nearer examination of those, who are qualified for the task, and who will greatly oblige the Mineralogists by making out, whether any coals are found under the volcanic strata of the *Habichwald*, which, if so, would greatly alter the hypothesis; but it never has appeared so to me. (*Transl.*)



*Toplitz, in the Circle of Leitmeritz.*

THE mountains from the above place to this, by the way of the *Oak-forest*, consist of granite; and the ground is continually sloping towards *Toplitz*, till at once it sinks abruptly into the plain.

The country about *Toplitz* consists of gentle *accumulated modern mountains* of clay, lime and coals. It is interrupted by some steep insulated higher mountains, which are calcareous, and seem to be detached parts of the lower and gentler flats, raised by some violent accident. This affords an excellent opportunity to distinguish the difference of the modern incumbent and the more ancient simpler mountains, and to observe how the former have been accumulated on the latter, when their vallies were large reservoirs of water, in which their several sediments were successively deposited.

The *hot wells* and the *bath* at *Toplitz* are objects too much and too generally known, to want any description of mine. The bath-water has a strong smell of *hepar sulphuris*. They tell here that, at the time of the earthquake at *Lisbon*, these

these wells, together with those at *Carlsbad*, decreased, and then burst out with great violence; whence they deduce subterraneous canals, reaching as far as *Portugal*. But the great distance seems not to be favourable to such a supposition; and a similitude of causes may have produced these phænomena in the same moment of time. Next to the town rises a large limestone stratum, and close by are loam pits, worked for kilns. Near the forest-gate is a coal-bed, covered with some fathoms of clay, which partly is fullers clay, and commonly contains lumps of crystallised pyrites. Immediately under this stratum is a stratum of wood-coals, or fossil-wood, some inches thick; and then the coal-bed, which appears four fathoms above ground, and has not been hitherto explored in its whole width. It consists of shivery coals, and many thin beds of clay, from five to eight inches thick. There are no regular works, the coals being dug as from a quarry. The shivery rubbish is burnt, and the ashes produced sold as manure or dung to the farmers.



## Graupen.

THE road from *Topliz* to *Maria-schein* runs over gentle and low hills of clay and lime. The detached granite, which now and then occurs, comes from the mountains on the other side of *Toplitz*. Near *Maria-schein* suddenly rises a large chain of high and steep mountains of gneiss, which include the basin on this side of *Toplitz*. *Graupen*, a tin-place, is at the foot of these mountains, which are called the *Knutler Gezirck*. Ascending these steep mountains I observed an old vein, worked out up to the turf; but found no remains of old bing-places. Two silver-veins, belonging to the community of *Graupen*, are still working; one called *S. Nepomuc*, the other *Silver-beeck*, which proves also in this place, that gneiss is generally a matrix of silver-veins, though here it likewise contains tin-veins, which commonly run in granite, and are then not interrupted. By means of a shaft sunk on a vein, they had discovered others, which unite at a small depth, and all of them are metallic. They might, by a draining level of two hundred fathoms, clear them to a considerable depth; and to judge of the bing-places

places and the ores, which I found there, it would be worth their while. I observed,

1. Sound lead glance with pyrites, and black jack in quartz.

2. The same with yellow blende.

3. Lead glance, blende and tin-ore in quartz.

4. Sound tin-ore and lead-glance in tin-stone.

5. Large pieces of crystallized tin-ore and blende.

6 Fluor with copper-green and azure.

The mixture of leadglance and yellow blende make it probable, that, in a greater depth, the tin will be followed by silver, as is commonly the case in the neighbouring mines of *Saxony*.

These veins are called silver-veins, in respect to the silver which is contained in the lead-ore; and besides them many tin-mines are working in the same mountain, but to no great advantage. I examined one of them, called the *Sweif*, in which they work on thin *soaring tin-veins* or *fissures*, which in respect to their flat and soaring extension greatly resemble the larger ones at *Zinnwald*, being like them crossed by many vertical or dipping veins, cut off or alter'd in their situation, and accordingly worked and pursued on the same principles.

They are in nothing different from those at *Zinnwald*, except in their thinness and in their  
want



want of skirts, being immediately grown to the sides of the country or rock, in which they are running. They consist in their whole width of solid *tin-stone*, and it is very rare to meet any quartz in them, which makes them bear the expence of working, although their width is scarce ever above half an inch. The beds or lamellæ of the gneiss-rock in the country, on both sides of the veins, are mostly vertical or standing upright. The soaring veins, if cut off or crossed by vertical ones, produce large joints or riders of tin-stone up and down in the vein. It would be worth enquiring whether these vertical veins contain any silver; but the miners in this place do not know nor care for any other than tin-stone. It is remarkable, that the surface of the mountain sinks and falls in the same direction, as the soaring tin-veins are raised or sunk by the crossing vertical veins.

From the top of this mountain the whole country or valley of *Maria-Schein* and *Toplitz* appears before you. It is covered by many gentle incumbent hills or flats, which are interrupted by some insulated conic steep granite-mountains, for example near *Mublschaw*, where a steep chain of granite-rocks rises above the ground, and shows to the coolest imagination, that the mountains at

*Graupen*

*Graupen* have been formerly the shore of a sea, which covered the valley of *Maria-Schein*, and above which the insulated granite-cliffs at *Muhlshaw* must have once appeared.

Muckenburg or Muckenthurm.

FROM the before mentioned old mines in the *Knutler-Gezirck* I pursued that ascending slope of the mountain to another line of old mines, which is called the *Altenberg*. I passed near *Creuzgang* and *Mansuetus*, which are still working on larger tin-veins than those at *Schweif*. Though five workmen are only employed in *Creuzgang*, the dividend however in 1767 consisted of 1400 florins, which greatly vouches for the riches of the mountain.

Hence it ascends rapidly towards *Muckenthurm* or *Muckenberg*, where they have in gneiss sunk a shaft on a large copper-vein, which they consider to be a *stockwork*. Here is the highest point of these mountains, many hundred fathoms above the valley of *Toplitz*; and hence they slope and sink towards *Altenberg* in *Saxonia*. *Gneiss-rock* continued to *Furstenaw*, where a variety of  
granite



granite appeared, which beyond *Geising* at *Altenberg* had its common and natural colour and mixture.

*Ratieborziz or Bergstedt, in the Circle of Tabor.*

THE silver-mines in this place are the property of Prince *Swarzenberg*. They are in gentle hills and grey or blueish clay-slate; in which are observed some fissures of greenish lithomarga, or half-indurated pot-stone earth or bacon-stone. A variety of veins, which cross those mountains, are worked to advantage.

Count *Kienburg*'s works at *Rzemizow*, a vein which is parallel to that at *Ratieborziz*. To the west of this place Cardinal *Migazzi* has a silver-mine. The old mines at *Tabor*, which were formerly so rich of native-and redgilder-ore, have been of late taken up again by Baron *Kesler*. Near *Budweiss*, and near *Rudolph* and *Adamstadt*, are many considerable old mines in different mountains, which are working partly by Her Royal and Imperial Majesty, partly by the citizens at *Budweiss*, and partly by prince *Swarzenberg*.  
They

They have of late found dendritical native silver at *Budweifs*.

The mines at *Ratieborziz* or *Bergstedt*, which belong to the prince of *Swarzenberg*, have been taken up again in 1719. There are several of them. 1. The *Chief-mine* or *Haupt-Baw* at *Bergstedt* consists of *Lawrence*, *Charles*, *Michel* and *Nichols*, which are drained by *S. John's* gallery or the deepest water-level. The veins are *S. Nichols* and *Charles*; both northern veins, or running from north to south, and dipping in about sixty degrees. *S. Nichols* dips to the east; *S. Charles* to the west. Where richest, they are about three inches; where yielding sprinkled and mixed ore, they are about two feet. The deepest sole is at present seventy fathoms vertical under ground. About fifty fathoms to the west, and in a direction parallel to their's, runs a foul vein twenty-five fathoms wide, which consists of mixed, white blue and yellow clay, and cuts off the crossing ramifications, which diverge from the chief veins in such a manner, that hitherto they have not been hit again beyond it.

2. The under-work near *Bergstedt*, pursues a vein which runs between hour two and three, and has lately yielded rich-ore in the *S. Anthony-shaft*. It contains lead-glance with silver, and that sort of specular blende which shall be spoken ]  
of



of hereafter. Where the rock softens and is mixed with quartz, there is likewise native silver.

3. *Dorothea*-mine and *S. George's gallery* are to the west of *Bergstedt*, for the present extremely rich, and work on two veins, which have united. One is called *S. George*, runs in hour two; the other is *Dorothea-vein*, which diverges from the former in the hanging runs in hour twelve. This was formerly extremely thin, ran in hard rock, and contained rosy-coloured feldspath, with some lead-glance blende and a little silver; but as soon as a joint with mispikkel came into the hanging, the vein produced white-and red silver-ore, native silver and glass-ore. *S. George* has in respect to *Dorothea* an irregular dipping, because it coincides or unites with it in the depth. As long as it continues running by itself, it is so much cut by foul clay-veins, that it produces but little and poor lead-glance and blende.

4. *Old-Woschiz-Hope God's Blessing-Gallery* was quick already fourteen years ago. They work here on a vein, which runs between hour nine and twelve, and dips between forty-five and seventy-five degrees. It is from two inches to one foot wide, and richest where thinnest. It is chiefly quickened by the coming-in of a winding undulating black clay fissure, which appears sometimes in the hanging; then

then it produces fallow, white-and red silver-ore. It is likewise crossed by some morning or eastern-veins, which affect it in a different manner; since, before they cross it, the vein appears cut off and dead, till, beyond the cross, it appears quick again in the former run; sometimes the ore and the vein are entirely lost or hid under the cross-joint, fall out extremely rich underneath it, but disappear entirely above it.

Three hundred and fifty men, the washers and smelters included, have here employment.

The gang or vein, or the metallic matrices in these veins are,

1. Fine white quartz partly transparent, partly crystallised. Some crystallisations are lamellous, having on the under part square regular impressions, as in the crystallisations from *Hodriz* near *Shemriz*.

2. White calcareous spar, variously transparent and crystallised.

3. Yellow transparent calcareous spar, crystallised like combs.

4. Reddish feld spath, remarkably found.

5. Clay, black, grey, and yellow.

6. Asbest like cork, in whitish, thin and flexible lamellæ.

7. Mispikkel or white arsenical pyrites, quickens the vein.

8. Sulphurous



8. Sulphurous pyrites occurs now and then.  
The silver-ores contained in these matrices are,

9. Native silver, like wire or hairs, commonly on mispikkel or on yellow cubic sulphurous pyrites.

10. Red-silver-ore, found and crystallised, transparent like ruby.

11. Glass-ore, found, cubic, and capillary.

12. White silver-ore.

13. Lead glance mineralised with silver, coarse or fine, cubic or polyedrous.

14. Brown or red blende, knotty or crystallised, contains much silver.

15. Specular blende, yellow or greenish, lamellous and transparent, occurs in large lumps, now and then under a crystallised form; broken, it consists of large lamellæ, which reflect the light like mirrors. It is extremely rich of silver.

The wash-and pounding-mills have nothing particular. But the above blende, containing much silver, and being for that reason smelted with the other ores, makes the smelting somewhat difficult. The medium of the silver-produce of these mixed ores is from 40, 50, to upwards of 100 ounces per hundred weight.

T H E E N D.

I N D E X.

# I N D E X.

## A

*Abud-banya*, a mining-place near *Zalathna* in *Transylvania*, has gold mines, page 117  
*Agathe*, white and red, in *Simon Judas* copper vein at *Dognaska*, which runs in metallic rock, 53  
*Alabaster* and *Gypsum*, constantly found in and about rock-salt-mines, 144  
*Alcaline salt*, native and fossil, at *Debreczin*, 4  
*Alum works*, at *Commotau*, 247  
*Antimony*, found with mineralized gold at *Nagyag*, 102  
———, with native gold, 129, 130, and at *Magurka*, 222  
———, grey and yellow plumose; if found in the veins at *Kapnik* improves their auriferous quality, 154  
———, grey plumose, in a hanging fissure of an auriferous zinnopel-vein at *Felfo-banya*, 160  
———, on quartz-crystals, 160  
———, radiated, on white pellucid rhomboidal prisms

of fluor, 160  
*Antimony*, red and grass-green, 160  
*Ardellia*, *Wallachian* name of *Transylvania*, 14  
*Argillaceous* rocks and stones, *Horn slate*, *Kneifs*, *Metallic rock*, *Schistous clay*, and *Trapp*, in *Hungary* incumbent on granite, 205  
and under limestone, which has changed them in some places into marl, 208  
*Arsenic crystallised*, or orpiment, found with mineralized gold, 102  
—— calx, dripping into the form of stalactites from *Joachimsthal*, 258  
*Arsenical*, such as tin-veins, crossed by iron-veins, produce silver in the *Saxonian* mountains, 264, 265  
——— veins, such a *mispikkel*, uniting with silver-veins, improve them, 318  
*Bannat* of *Temeswar*, its limits and government, 7  
——— 10  
inhabitants, 14  
mines, 24—27  
*Basaltes*



# I N D E X.

- Basaltes columnar prismatic*, incumbent on Gneifs and on granite, 228  
 ———, with black crystalized fherl, 228  
 ———, (grains) in metallic rock, 33, 34  
*Blachmann*, a name given at *Kremniz* to white silver-ore, which incrustates quartz, 219  
 ——— At *Shemniz* it signifies a pyritical incrustation of glass and other rich silver-ores, which it is constantly found concomitant, 219  
*Blasting* of the mines, invented at *Freyberg* in 1613; or in 1627, from *Hungary* introduced in *Germany*, 192  
*Blende*, with native gold, 129  
 ——— (specular) yellow and greenish, transparent; rich of silver; from *Ratieborziz* in *Bohemia*, 320  
*Bloksberg*, the highest mountain in *Germany*, and in the *Harz-forest*, consists of granite rocks, either stratified or confusedly piled up, 231  
*Boicza*, rock, veins, mines and ores, 127, 128  
*Born* (*Baron*) in danger to be suffocated in the mines at *Felfo-banya*, 158  
*Brush-ore*, a species of native silver, found at *Joachimsthal*, 271  
*Cassel* (painters clay) described, 307  
*Cat-gold*, or yellow laminated mica skirts and includes the tin-veins in-granite at *Zinnwald*, 309  
*Caverns* subterraneous, generally found in calcareous mountains; but one of late discovered in slate-rock at *Joachimsthal*, 267, 268  
*Chalcedony*, or white hornstone, with petrified corals, near *Lehotka*, 194  
 ———, milky, stratified, with detached jasper and agathe, in the same place, 194  
 ———, (blue) incrustation of iron ore 221  
 ———, (blueish) dripped as stalactites on iron-ore, 199  
*China-clay*. See *clay*. *Kaolin* and *Petuntse*; a vein in granite-rocks under the *Blockberg*, 232  
 ———, probably to be found in every tract of granite mountains, 232  
 ———, produced from decaying granites, 232  
 may be produced perhaps by artificial decompositions of granites, 232  
 ——— and porcellanites or indurated china-clay found in *Bohemia*, 252  
*Cinnabar*, solid and scaly, at *Dumbrava*, 120  
 ———, granulated at *Bojoja*, 120, 121  
 ———, in a limestone vein, 120, 121  
*Clausenburg*,

# I N D E X.

- Clausenburgh*, ancient Roman colony, 146
- Clay*, the substantial earth of mica, glimmer, quartz feldspath and other flints, as mouldering and decaying into clay, 229, 230, —235
- , substantial earth of coals, 305—309
- , produced from mouldering granite, gneifs and micaceous slate, 230—235
- , from volcanic ashes and substances, 309
- , (*auriferous*) with pyrites, in the veins at *Kapnik*, 155
- , (*auriferous*) grey, at *Facebay*, 110—112
- , (*blue*) with auriferous pyrites, 129
- , (*blue*) in slate, a vein producing orpiment, 195
- , (*black*) with auriferous pyrites, 129
- , (*grey*) a vein in slate, with quartz and copper pyrites, at *Smolniz*, 170 —172
- , (*Painters*) from *Cassel*, described, 307
- , (*white*) with auriferous lead-glance, 129
- Coal-bed*, near *Wilkishen*, seems to be a stratum of old pretended primitive slate, impregnated by petroleum and covered with detached decays of granite, 300, 301—305
- , on the *Habichwald*, surrounded with volcanic productions, destitute of any roof, consists of clay saturated with petroleum; perhaps produced from volcanic ashes and cinders, 305
- Coal bed*, at *Toplitz*; common and fossil wood-coal, 311
- Cobalt*, with silver-ore, common in the veins at *Joa-chimsthal*, 257
- , formerly thrown away in *Bohemia* as rubbish, 258
- , (*grey scaly*) with native gold, 129
- Combs* or *Wacken*, popular names given in *Bohemia* to large vertical veins of porphyry and trapp, 262
- Copper*, cemented at *Smolniz*, 172
- , (*ore*) *a. Azur*, or *blue*, crystallised, &c. in quadrangular oblong truncated forms, 31
- , *B. in* polyedrous semipellucid forms from *Saska*, 40
- , *b. Brown*; an undescribed species of jasper, mouldering into red copper mulm or tile-ore, from *Saska*, 39
- , *c. Broth-ore*; a copper-pyrites penetrated with brown copper-mulm, 31
- , *d. Glass*; red, crystallized in triangular and octangular forms, from *Saska*, 38, 39
- Copper



# I N D E X.

*Copper, (ore) e. Mulm; at  
Saska incumbent on lime-  
stone,* page 35, 37

———, *f. Native, on  
lead-glance from Illobor,*  
166

———, *g. Pitch-ore; produced from hardened  
copper-mulm at Saska,* 40

———, *h. Red-ore, or  
Tile-ore, or red copper-  
mulm, produced from  
mouldering decaying jas-  
per, 39, and found at  
Oravitza,* 31

———, *i. White arseni-  
cal,* 31

*Copper, (smelting) in the  
Bannat described,* 57

———, *Proposals of Mr.  
Delius to improve the ope-  
ration, and to soften the  
copper by additional sul-  
phur, or a sulphureous  
regulus,* 63

*Copper, (veins) At Dog-  
nazka; Simon Judas, er-  
roneously called a stock,*  
51

*In metallic rock incum-  
bent on gneifs,* 51

*Consists of copper py-  
rites, white limestone,  
spar, agathe, and yellow  
or black garnets,* 53

———, *Mary-Victory, in  
metallic rock, consists of  
dissolved mica and cop-  
per pyrites,* 54

———, *At Gelniz, in  
horn-slate, running from  
west to east, consist of  
grey quartz, some spar,*

*copper pyrites, and grey  
copper-ore,* 176

*Copper (veins) At Moldova,  
run in every direction,  
between grey argillaceous  
slate and a hanging of  
limestone, both incumbent  
on gneifs,* 44

———, *At Muckenthur-  
mel in gneifs,* 315

———, *At Newfol, in argil-  
laceous slate, running from  
north to south, dipping  
from east to west, between  
forty and fifty degrees,  
cut off by an oblique cross  
joint of red irony argilla-  
ceous slate; consist of com-  
mon shistous clay, mixed  
with mica, quartz, gyp-  
sum and copper ores,  
which are auriferous in  
some places,* 195, 196

———, *At Oraviza, in  
the mountains of Cosho-  
wiz, run between argil-  
laceous slate and lime-  
stone, consist of calca-  
reous and selenitic stones,*  
28, 29

———, *in the mountains  
of Cornudilfa, run in  
limestone, consist of gyp-  
sum and phosphorescent  
spar*

———, *At Saska, run  
between marle mixed with  
basalt grains on the hading,  
and limestone on the hang-  
ing side, consist of calca-  
reous or selenitic spar  
with some quartz, 33—35*

———, *At Smolniz, in  
blue*

# I N D E X.

- blue glimmery argillaceous slate, parallel to each other, run in hour six, dip in seventy-five degrees, improved and altered in their direction by small cross-joints, consist of dark grey clay with quartz and copper-pyrites, 171, 172
- , At Swadler, in glimmery argillaceous slate, 176
- Corfars*, strolling merchants allowed to purchase gold from private mines and wash-works in *Transsylvania*, 126
- Crystallisations*, with inclosed water, or *crystalli enhydri* at *Kapnik*, 155
- , (*quartz*) great variety in the large veins at *Shemniz*, 189
- Csertes*; gold mines in metallic rock, 123
- , auriferous glass-ore in hornstone, 122
- Debrezin*; fossil and native alkaline salt, 4
- Delius* (*Cristoph. Trawgott*) proposals to soften copper by sulphur, or an additional sulphureous regulus, 63
- Dembsher* (*Francis*) examination of the gold-dust and and gold-washings in the *Bannat*, 83—93
- Deva*; its copper stock-work, 94
- Diamonds*, white and red, white and yellow in the imperial cabinet at *Vienna*, 226
- Dognazka*; veins, rocks and ores described, 47—56
- Ducca*; a generous character of a man, 10
- Electrical* evaporation of a pyritical vein, during a thunderstorm, 60
- Entomolithus paradoxus trilobus*; an undescribed species in the sandstone beds on the *Harz-forest*, 251
- Facebay*, near *Zalathna*. The *Maria Loretto* gold-mine consists of a small stratified auriferous sand-stock and gold-veins, 110—117
- Feld-spath* (red) in the gold-vein at *Nagyag*, 101
- , matrix of auriferous fallow silver-ore at *Kapnik*, 153—155
- , the redder the more auriferous, 155
- , with silver, common in the richer veins, 220—319—320
- , its red colour owing to iron, 155
- , in metallic rock, 127
- Felső-banya*; a mining place, mountains, veins, works and ores, 158—166
- Firing* of mines, at *Goslar*, *Schlackenwalde*, and *Felső-banya*, 161
- Fissures* or *Klufte*, smaller veins, less constant and wide in their run and dipping, 28
- Fluor* cubic; with inclosed native



# I N D E X.

- native sulphur, 160
- Fluor*, in rhomboidal prisms 160
- , blue } with  
 ——, green } quartz  
 ——, yellow }  
 in a tin-vein in granite at  
*Zinnwald*, 309
- Freygold (Martin)* at *Freyberg*, said to have invented the blasting of mines by gun-powder, 192
- Fridwalzky (P.)* at *Clausen-berg*, author of a *Nat. History of Transsylvania*, 106, 107, 146, 147
- Fuezes*; mines, rocks, veins, and ores, 124, 125
- Gang*. See vein
- Gang mountains*; German name of ancient metallic mountains, which by some philosophers too inconsiderately have been called primitive mountains, 302
- Garnets*, found with gold-dust in the Bannat, 71  
 —91
- , in grey micaceous and argillaceous slate at *Bleystadt*, 267
- , (yellow and black) with eighteen or thirty-six points in *Simon Judas* vein at *Dognazka*, 53—56  
 in *Paul's* lead-mine in the hading of the former, 54  
 At *Dognazka* erroneously called yellow blende, 56
- Gelft*; common name of pyrites in some *Hungarian* mines, 217
- Gipsies*, in the Bannat of *Temeswar* and in *Transsylvania* commonly employed in gold washing, 76
- Glass-ore*. See copper-ore; or native silver from *Joa-chimsthal* 272
- Gneiss*, an argillaceous rock or mixture of quartz, mica and white or reddish clay, 243
- , the mountains at *Catharinaberg* and *Graupen* in *Bohemia* consist of it, 228—312
- , the veins at *Catharinaberg* filled with it, 245
- , at *Saska* cap'd with argillaceous slate and limestone, 42—52
- , under columnar basalt, 228
- , incumbent on granites, 236, 205
- , insensibly connects and degenerates into micaceous and argillaceous slate; accordingly to be consider'd in respect to situation as a variety of argillaceous slate; but in respect to mixture it is a variety of granites, 229  
 —236—247
- , degenerates at *Com-motau* into common argillaceous slate, 247
- , white, silver-coloured, blueish and dark-coloured at *Presniz*, 248
- Gneiss*

# I N D E X.

- Gneiss*, Silver-vein in it, 248, 312  
 ———, is a common matrix of silver-veins, 312  
 ———, contains, besides the silver-veins, tin-veins at *Graupen*, 312  
 ———, copper veins at *Saska*, 42, 52 and at *Muckenthurm*, 315  
*Gold-dust and washings*; in the Bannat of *Temeswar* found in the river sand and beds, which are parallel to the turf, and consist of loam, rockstones, mica, garnets and fine irony-sand, incumbent on slate or brown sandstone and coals, 77, 78—84 —87—91  
 ———, in the Bannat not to be described to any gold-veins, since never-found sticking to any matrix, 86  
 ———, its origin investigated, 92  
 ———, its washings in the Bannat described and examined, 76  
 ———, in *Transsylvania* found under the turf in a sandy stratum, incumbent on argillaceous slate, 136  
 ———, all the brooks in *Transsylvania* carry gold-dust, 137  
 ———, is washed by the *Wallachians* in *Transsylvania*, and produces every year about a weight of thousand pounds, 110
- Gold-ore*, according to a popular opinion of the *Transylvanians*, found only immediately under the surface of the horizon, 121 —130  
*Gold-ore*. See *gold-dust*, *zinnopel*, and *veins*,  
 A. *Native*.  
 1. In calcareous spar from *Staniza*, 129  
 2. In radiate antimony, from *Staniza*, 129  
 3. In grey scaly cobalt from *Staniza*, 129  
 4. On blende and lead-glance, 127  
 5. In black lead, 226  
 6. On selenite from *Fuezes*, 125  
 7. On auriferous pyrites and black hornstone, 129  
 8. In grapes and pretended vegetable gold are gross impositions or mistakes, 225  
 9. On zinnopel, 166  
 B. *Mineralized*.  
 1. Lamellous, splendid, black-grey, or woven in feldspath, from *Nagyag*, 98—101 found with native silver, 101, 102, and orpiment, 102  
 2. like scaly antimony from *Nagyag*, 102  
 3. In pyrites, or sprinkled upon as *Spanish snuff*, from *Facebay*, 115
- Y 4 *Gold-ore*,



# I N D E X.

*Gold-ore,*

*C. Auriferous ores or Substances.*

1. Calcareous auriferous earth, found by nodules in the veins at *Kapnik*, 154
2. Red silver-ore auriferous, from *Trsztyan*, 129
3. Glass-ore auriferous in horn-stone, 122
4. Lead-glance auriferous, in white clay, at *Kisbanya*, 129
5. Pyrites auriferous, in blue clay, from *Herzigan*, 128
6. ——— in black hornstone, from *Ginel*, 129
7. ——— in black clay, from *Cajonel*, 129
8. ——— on quartz, from *Cajonel*, 129
9. ——— on blende from *Cajonel*, *ibid*

*Gold-veins, running*

*A. In metallic rock. See metallic-rock*

1. At *Abrud-banya* near *Zalathna*, 117  
In the *Kirnik-mountain* they are thin and short; being firstly vertical and deaf for eight fathoms; then dipping till they become soaring and auriferous for about two fathoms, when they turn again and break of, 118

2. At *Boicza* the metallic rock is covered with limestone, and the

veins consist of blendish and auriferous lead-glance

127

*Gold-Veins in metallic rock.*

3. At *Csertes*, the metallic rock cap'd with slate, 123

4. At *Kapnik*, run from north to south, dip from west to east; consist of red feld spath, fallow auriferous silver-ore, auriferous quartz and clay,

152—154

Their auriferous quality diminishes in the depth, 155, increases wherever antimony appears, 154

5. At *Kremniz*, run from south to north, consist of solid quartz, auriferous red and white silver ore and auriferous pyrites, 194

6. At *Nagyag*, the metallic rock covered with red clay, run from north to south, consisting of red feldspath and white quartz

97—101

7. At *Rota*, run between greenish calcareous and white metallic rock; contain blende, lead-glance and native gold,

155, 156

8. At *Sargo-Banya*, consist of auriferous silver and lead, 165, 166

9. At *Shemniz*, run from north to south, consist of quartz, lead-glance, and zinnopel; produce gold,

# I N D E X.

gold, silver, lead, 181  
—190

*Gold-veins, in metallick rock.*

10. At *Topliza*, in metallic rock cap'd with slate consist of auriferous quarts native gold, auriferous silver, and lead-ores; run from south to north, immediately under the turf, 123, 124

11. At *Ui-banya*, or *Konigsberg*, run between metallic-rock and granite; consist of grey quartz and auriferous pyrites, 200

*B. In Hornstone.*

1. At *Facebay*.

a. *Sigismund gallery*, consists of quartz, hornstone, auriferous pyrites, auriferous clay, and gold mineralized with pyrites, 110—112

b. *Maria Loretto*, consists of two parallel veins and a stratified auriferous sandstone stock, containing mineralized gold in pyrites, 110—113  
—117

2. At *Felfo-banya*, run in grey hornstone and metallic rock, which is under the former; consist of zinnopel, which contains gold, silver and other-metals, 159—164

*Granite*, under columnar basaltes, between *Lowosiz* and *Topliz*, 228—under gneiss 225—236  
Is the undermost stratum

of the highest mountains and deepest mines in *Hungary* and *Transsylvania*, 202,—203

*Granite*, appears no where incumbent on or alternating with other rocks, 204

however may be incumbent in unexplored depths on simpler rocks, hitherto undiscovered, 204

does not contain any metallic veins in *Hungary*, 204

contains many tin-veins in *Bohemia*, which consist of granite at *Platte*, 263  
at *Catharinaberg*, 245—at *Zinnwald* 307—309

The tin-stock at *Schlackenwald* consists of granite, striped with pure quartz and tin-ore, 291. This tin-stock surrounded with gneiss  
ibid

A piece of granite with a fragment of slate sticking in it, 207, 208

Was in a state of paste and ductility when in some places slate was accumulated on it, 207, 208

A grey and reddish species near *Kladraw* breaks and naturally splits into cubical and rhomboidal forms and prisms,



# I N D E X.

- prisms, 297
- Granite*, may be produced by modern revolutions, as appears by the lava's which resemble to granitello, 289
- If its feld-spath particles moulder into clay, it is called gneifs, 231, and petuntse, 232
- Produces by mouldering argillaceous slate and gneifs, 229—236—247. Clay more or less mixed with quartz, mica and feld-spath particles, 229—236—247. Perhaps china-clay, 230—235. quartzous sand, 231
- Contains iron-veins at *Platte*, 262
- With black crystallized spherl, 296
- Granitello*, resembling to some lavas, 289
- Gyalter*, an iron mine, 131
- consists of small stocks or nodules in grey and brown argillaceous slate 131
- Gypsum*, constantly found in and about the rock salt-mines, 144
- , pellucid striped white in the rock-salt at *marmaros*, 165
- Habichwald* near *Cassel*, coal-mine described, 305
- Halotrichum Scopoli*, seems to be an efflorescence of vitriol, 223
- Herrings*, fished now and then in fresh water in the *Szamos*-river in *Hungary*, 166
- Horn-slate*, (*Corneus Wallerii*) consists of quartz closely mixed with mica and clay, incumbent on granite, contains in *Hungary* some thin metallic veins, 205
- Never contains any quartz-veins, and is found near *Wilkschen* in *Bohemia* in horizontal beds, 296, 297—moulders into clay, 130—240
- is a variety of grey micaceous slate, and called in *Bohemia* *pochwacke*, 260
- A vein of blackish slate running in it at *Platte*, 261
- Quartz and copper-veins running in it at *Golniz*, 176
- Antimonial-veins running in it at *Rosenaw*, 177
- Horn-stone* (*Corneus Wallerii*) at *Facebay*, incumbent on argillaceous strata, contains rich gold-veins, and seems to be produced by modern floods or revolutions, 212, 110, 114
- in *Hungary* never found incumbent on lime, 213
- contains auriferous silver-veins at *Csertes*, 122
- And problematical round holes, 114
- By *P. Fridwalzky* erroneously called calcedony, 119
- a. *Black*, with native gold, 129
- b. *Grey* (*petrofalex*) incumbent on metallic rock,

# I N D E X.

- rock, with auriferous silver and zinnopel-veins, at *Felfo-banya*, 159---164
- Grey*, and flint-like, fills a vein at *Joachimsthal*, 260
- *c. Red*, semipellucid, flintlike, in the northern veins at *Joachimsthal*; the matrix of the richest silver-ores, 260—272
- *d. White*, schistous and rocky, resembling to calcedony, and flintlike, stratified, with petrifications of corals; near *Lehotka*, 194
- Hot-wells*, at *Ofen*, 4
- , at *Shemnitz*, in limestone, produce calcareous tophus with iron ocher, 193, 194
- Hysterolithus*, *alatus planus latior*, in the sand-stone beds on the *Harz* forest, 251
- Jacquin*. At *Vienna*, 226
- Jasper*. See zinnopel,
- , *Red* or deaf zinnopel, found in micaceous clay-slate near *Shemnitz*, 185
- , *Brown*, an undescribed species moulders into red copper-ocher, 39
- Joachimsthal*. The mountains black slate, 254
- . The veins unaffected by the direction of the valleys, 257
- . The mines extremely deep, 256
- Joints* or cross-fissures, called *Kleins* in *Hungary*, 171
- Iron-ore*, incrustated with blueish dripped calcedony from *Poinik*, 199
- Iron-ore*, sand with gold-dust in the *Bannat* and in *Hesse*, 77—91
- Iron-veins*, at *Orpes*, soaring between limestone and incumbent white argillaceous stone, 250
- , in slate, at *Stoofs*, *Krumbach*, *Abavira*, *Rhoniz*, *Poinik*, 175--177 199
- , in granite, or between granite and slate, at *Platte*, 262
- , uniting with arsenical ones, such as tin-veins, produce silver in the *Saxonian* mines, 264, 265
- ore appears in the upper-drifts of the tin-vein at *Gotte-gab*, 265
- Kaolin*, is the substantial earth of granites, 232
- Kapnik* mountain-rock-veins, and rich gold-ores, described, 152--154
- Kirnik-mountain*, contains a great number of short and rich gold-veins, 117
- Klein*, a popular *German* name used in *Hungary* for the cross-joints of the main vein, 171
- Kluft*. see *Fissures*.
- Kneifs*. See *Gneifs*.
- Koczian's* observations on the gold-washings in the *Bannat*, 76
- Koleferi* (*Sam.*) *Auraria Romano Dacica*; or account of the ancient *Roman* antiquities and mines in *Trans-*



# I N D E X.

- Transsylvania*, 106  
*Kremniz*, a great mining place, mountains, veins, ores and works described, 194  
*Lava's*, some resembling granitello, 289  
 ———, *vitreous* or pretended *Iceland-agathe*;  
*a.* black.  
*b.* blueish, semi-transparent, in detached pieces near *Tockay*; called *lynx* or *lux-sapphires* in *Hungary*, 167  
 ———, See *metallic rock*, *Nagyag*, and *volcanic productions*.  
*Lead glance*, auriferous, 129  
 ————, 124  
 ————, and with native gold in white quartz and blende at *Rota*, 155, 156  
*Lead-vein*  
*A.* In limestone; at *Molditska*, 199  
*B.* In slate, 132—267  
*C.* In metallic rock, at *Dognazka*, 47, 48  
 At *Topliza* and *Fuezes*, contains native gold, 124  
*Limestone*, incumbent on clay, metallic rock and granite, with sea-shells at *Bogshan*, 62  
 ———, incumbent on argillaceous slate, 24--28  
 ———, constantly incumbent on clay, contains in *Hungary* some lead and copper veins, 206  
 ——— often immediately incumbent on granite, 207  
*Limestone*, a cinnabar-veinin it, 120, 121  
 ———, (*scaly*) occurs in the *Simon Judàs* copper vein at *Dognazka*, 53  
 ——— seems to have had a different origin, and to be either ancient or accidental, 210, 290  
 ———, the granulated and scaly destitute of petrifications, 210  
 ———, the accidental and modern limestone beds, containing petrifications, are in *Hungary* destitute of metallic veins, 211  
 ———, tophus, like stalactites in globular and columnar forms, produced near *Liptaw* by the waters coming from the higher *Carpathian* mountains, 198  
 ———, copper-veins in it at *Oraviza*, 28, 29  
*Lux and Lynx-Sapphire*, in *Hungary*, a popular German name of vitreous blackish and blueish semi-pellucid lava; erroneously called *Iceland-agathe*, 167  
*Manganese*, red, crystallised in a hanging fissure of an auriferous zinnopel-vein, 161  
*Marmaros-stones*, octangular alum-like quartz-crystallisations, 165  
*Mercury-mines*. See *Cinnabar* and *Quicksilver-veins*  
*Metallic-rock*, an argillaceous rock, mixed with mica, quartz,

# I N D E X.

- quartz, feldspath and basalt-grains, 33, 34
- Metallick-rock*, is so called in *Hungary* (or rather by *Baron Born*) because the richer mines of that country are constantly found in it, 33, 34
- , immediately incumbent on granite, 205 206
- , under the argillaceous slate, 181--123 --97--135
- , (grey) with shirl, quartz and spar-grains; the common rock at *Kremniz* and *Shemniz*, 181--191--123
- contains gold and lead-veins, 123--125 --165--166
- , a variety, instead of mica mixed with lithomarga, as a wedge or stock in the common metallic rock, 189
- (white) with lithomarga, contains veins of quartz and clay with auriferous silver, gold and antimony, 152--154--191
- , a variety, naturally split and broken, in flat regular pieces, near *Nagyag*; resembling to some lava's from the *Euganean-mountains*; seems to be a volcanic production, 133
- , a variety formed like bullets, found in the sound metallic rock near the *Theresia-vein* at *Shemniz*, 188
- Metallic-rock*, erroneously called sandstone at *Dognazka*, 54
- , contains gold-veins at *Abrud banya*, 117
- at *Csertes*, 123
- at *Kremniz*, 194
- at *Nagyag*, 67-105
- at *Nagy-banya*, 150, 151; likewise silver
- at *Sargo-banya*, 165, 166; likewise lead
- at *Rota*, 155, 156
- , contains copper-veins at *Dognazka*, 51
- Mica*, produced from clay, into which it moulders again, 229
- , white and dissolved in the copper veins and rocks at *Dognazka*, 54
- , (yellow) on cat-gold skirts, and incloses the tin-veins in granite at *Zinnwald*, 309
- Mispickel*, uniting with a silver-vein improves it, 318
- Moldova*; veins, rocks and ores described, 44
- Mountains*. Their distinction into *primitive* or *primogenial* and *secundary* or *accidental* modern mountains, is merely relating to the different times and accidents of their origin, and implies no real difference in their substances, 302
- , *incumbent* or *accumulated*, are modern in respect to the lower strata on which they are accumulated, 310
- Nagyag*, properly called *Sekeremb*,



# I N D E X.

- keremb*, a gold-mine and mining place, 96—105  
*Nagy-banya*, mining, place, auriferous silver in metallic rock, 150, 151  
*Newfol*, mining place, mountains, rocks, veins, ores and works, 195—98  
*Nummularii*, or *lapides numismales Transsylvaniæ*, from *Torda*, 143  
*Ofen* petrifications and hot-wells, 3, 4  
*Orpiment*, or crystallised arsenic, in a vein of blue clay in slate, incumbent on metallic rock, 195  
 —, with mineralized gold, 102  
 —, with native sulphur, 160  
*Pest*, a city in *Hungary*, 3  
*Petrifications* of sea shells in limestone near *Ofen*, —near *Clausenburg*, 146—149  
 —, in white stratified hornstone or calcedony, at *Lehotka*, 194  
 —, in a trap-vein, running in old slate-mountains, a petrified tree, called the *diluvian-tree*, 265  
 —, in a zinnopel vein at *Shemnitz*, *madrepores* or *porpites*, 184, 185  
*Petunse*, is decaying granite, in which the feldspath moulders into clay, 232  
*Plajashes*, a national militia in the Bannat of *Temeswar*, 10  
*Pocket-work*, used before the blasting of the rocks, 188  
*Porphyry* (red) (veins) uniting with the veins at *Aberdam*, improve them with silver, 260  
 —, or large combs at *Joachimsthal*, quicken the vein, 261, 263  
*Primitive* or *primogenial* mountains, a precarious denomination, implying only that they are anterior in time to the origin of the incumbent more modern strata and mountains, 302  
 —, caverns discovered in them at *Joachimsthal*, 267  
 —, petrifications, but very scarce, in the veins which run in them, 265 —184—185  
*Pyrites* in a tin-vein at *Zinwald*, 309  
 — quickens the tin-veins at *Gottesgab*, 266  
 —, auriferous, in clay, hornstone, quartz and blende, 115—129  
 —, called *gelft* by the German miners in *Hungary*, 217  
*Pyritical vein* gives an electrical flame during a thunderstorm, 60  
*Quartz* quickens the copper-veins at *Smo'niz*, 172  
 — (*auriferous*) and lamellous, 191  
 —, with native gold, 129, 130  
 —, (*crystallisations*) pointed on both ends, 160  
 —, octangular alum-like

# I N D E X.

- like from *Marmaros*, 165
- , in a tin-vein in granite at *Zinnwald*, 309
- , (*fat*) in the gold-vein at *Nagyag*, 101
- , (*grey*) vein, between granite and metallic rock, contains gold-pyrites at *Konigsberg*. 200
- , (*irony*) auriferous, 217
- , (*milky*) with native sulphur, 160
- Quicksilver-veins* at *Dumbrava*, near *Zalathna*, run in argillaceous slate and sandstone, consists of quartz, spar and found scaly cinabar, 120
- At *Boboja*, run in limestone, contain granulated cinabar, 120, 121
- Raizes*, a *Sclavonian* tribe, calling themselves *Srbi*, inhabiting *Servia* and the *Bannat* of *Temeswar*, 14.
- , their language *Sclavonian*, 14
- , their character, 22
- , use the *Greek* alphabet, 23
- Raspe's* (*R. E.*) description of the *Blockberg* 231
- , of granite-sands and clay, 231, 232
- , on the origin of china-clay, kaolin and petunse, 232
- , on the origin of quartz sand, 232
- , description of marine sand-stone-beds with unknown petrifications, incumbent on the higher slate-mountains of the *Harz-forest*, 250
- description of the coal-beds on the summit and around the *Habichwald* in *Hesse*, 305
- Rock-salt*, at *Marmaros* surrounded with micaceous clay-slate, 165
- , at *Torda*, incumbent on argillaceous slate, cap'd with limestone beds, 140
- , consists of stratified salt, 141
- , gypsum and alabaster found between the salt-strata at *Marmaros*, are common near the salt-mines, 144
- , with included water-drops, 143
- Romun*, name of the *Wallachians* in the *Bannat*, *Transsylvania* and *Wallachia*, 14
- Rose-spar*, species of calcareous lamellous red-spar, peculiar to a mine at *Joachimsthal*, 260
- , with red silver-ore, 272
- Saalband* the fimbriæ, out-shirts or side-covering of metallic veins; not constantly appearing smooth and polished as slickon-sides, but often grown to the sides of the mountain-rock, 155
- , of the tin vein in granite at *Zinnwald*, consist of yellow mica or cat-gold, 209
- , many veins, as the tin-



# I N D E X.

- tin-veins at *Graupen* in gneiss have no skirts, but are immediately grown to the sides, 313, 314
- Sal-ammoniac* manufactory at *Bronsvic*, 145
- Salt native*. See *Rock-salt*.
- Sandaraca*. See *fulphur*.
- Sand (quartz)* on the sea-shores and the plainer countries probably, produced from decayed granite rock, 232, 233
- Sandstone*, incumbent on argillaceous slate and metallic rock, 195
- , with red native sulphur, 195
- , stratified mineralized gold-pyrites in a stock at *Facebay*, 113
- , surrounds in *Hungary* the nobler metallic mountains, 211
- , incumbent on limestone, 211
- , destitute of metallic-veins, 211
- , accidental modern slate-beds often incumbent on sandstone, 211
- , with petrifications, 139
- , of unknown sea-shells on the higher metallic and ancient mountains of the *Harz-forest*, 250
- Sapphire*, (*Lynx* or *Lux*) a vitreous semi-pellucid blackish and blueish lava from *Tockay*, 167
- Saska*. See *veins*.
- Saska*, copper-ores described, 37—41
- Sezugass* (*Baron*) 9, 10
- Selenite*, with native gold, 125
- Shemnitz*; mining place, mountains, rocks, veins, ores and works, 180—194
- Sherl (crystallised)* in metallic rock, 123—181—191
- a. *blue*, columnar, hexagonal or polyedrous, truncated, on copper-ore from *Saska*, 40
- b. *black*, in *Bohemian* basaltés, 228
- in granite, 296
- c. *green*, in trap at *Joa-chimsthal*, 263, 264
- Skalka* (composed of the *Hungarian* article *is*, and the word *Kalika* a point or summit) the name of the top of a mountain in *Hungary*, which produces red native sulphur in sandstone, incumbent on clay-slate and metallic rock, 195
- , name of a sandstone quarry on the summit of the *Harz-forest*, 250
- Silver-ore*,
- a. *Blackmann* signifies at *Kremnitz* white silver-ore incrustating quartz, 219
- At *Shemnitz* it has another signification, 219
- b. *Brush-ore*, a species of native silver from *Joa-chimsthal*, 271
- c. *Fallow*, auriferous, in feldspath from *Kapnik*, 153
- d. *Glass-*

# I N D E X

- d. Glass-ore*, in cubic forms, 218
- Silver-ore*, is mineralized with sulphur, 218—272
- e. Goose dung-ore*, 219, 220
- f. Mulm*, 220
- g. Native silver*. See *Brush-ore*.  
     from *Joachimsthal*, 271  
     with mineralized gold at *Nagyag*, 101, 102  
     on pyrites, 218
- g. Native-silver dendriti- cal*, from *Budweiss*, 316, 317
- h. Plumose*  
     1. *Grey*, in quartz, 219  
     2. *White*, in irony quartz, 219
- i. Red*.  
     1. *auriferous*, 124--129--  
         at *Kremniz*, 218  
         at *Topliza*, 124  
     2. *Crystallised*, at *Joachim- sthal* ruby-coloured and pellucid, 257  
         from *Saxony*, somewhat darker, 257  
         from *Andreasberg*, darker, 257  
         on rose-spar from *Joa- chimsthal*. 269—272  
         on cobalt, arsenical py- rites and red horn-stone from *Joachimsthal*, 272
3. *Dendritical* and in glo- bular lumps, 218, 219
- k. White*, auriferous at *Kremniz*; and called *Blachmann* when incrusta- ting quartz, 219
- Silver-veins*. Iron fissures in *Saxonia* uniting with ar- senical-ones, such as tin- fissures, produce silver, 264, 265—313
- Silver-veins*, by uniting ar- senical ones improved, 318
- A. In *gneiss*, at *Presniz*, 241—at *Graupen*, 312  
*Gneiss* being a common matrix of silver, 512
- B. In *Hornstone*, at *Csertes*, 122
- C. In *metallic-rock*. At *Kremniz* run from south to north, consist of solid quartz, and auriferous red and white silver-ore and pyrites, 194  
     At *Nagy-banya*, with auri- ferous silver, 150, 151  
     At *Shemniz*, run from north to south, consist of quartz, lead-glance and auriferous jasper or zinnopel, 181 —190
- D. In *black clay-slate*. At *Joachimsthal*, still quick in a depth of 350 fathoms, 254—257  
     At *Clausthal* in the *Harz- forest*.  
     At *Weipert* in *Bohemia* between *gneiss* and in- cumbent slate, 253
- E. In *grey and blue clay- slate*, at *Ratieborziz*, 316
- Slate*, fragments of slate in granite, 207, 208
- A. *Argillaceous* or *clay-slate*; of the *old-metallic* and pre- tended primitive moun- tains, in respect to its mixture, the same as that which is found in modern mountains; but is diffe- rent in respect of anti- quity



# I N D E X.

## *Slate, A. Argillaceous.*

quity and origin, 289  
 Produced from granite and gneifs mouldering and decaying into clay; as appears from its being immediately connecting in the same mass with gneifs, 229—247—by petroleum changed into coals, 305  
 At *Kladraw* in *Bohemia* breaks and broken in regular cubic forms, or in rhomboidal prisms, 297  
 incumbent on granite, 47  
 incumbent on metallic rock, 195  
 under limestone, 24—28  
 contains iron veins and stocks, 192—177—131  
 lead-veins in it, 192—132  
 copper-veins in it, 206—at *Newsohl*, 195, 196  
 At *Oraviza* under a hanging of limestone, 28, 29  
 silver veins, 253, 254—257—316

*B. Blue, micaceous clay-slate*, contains the copper-veins at *Smolniz*, filled with dark grey clay and quartz, 170—172

*C. Grey, micaceous clay-slate*, is a variety of horn-slate, 260

forms and fills a vein in horn-slate, 261

incumbent on granite, contains at *Aberdam* silver and cobalt-veins, and sometimes tin-veins ascending from the deeper granite, 259

At *Dognazka*, contains copper-veins, 47

## *C. Grey, micaceous slate.*

incumbent on gneifs, covered with limestone. 44  
 consists of grey clay and mica, 240—243  
 contains iron-veins at *Stoofs*; and between them some nests of copper-ore, 175

At *Moldova*, 44  
 copper-veins at *Swadler*, lead and quartz-veins at 176

*Bleystadt*, 267

*D. Horn-slate* See *Horn-slate*.

*E. Modern argillaceous slate*, incumbent on sandstone and lime, caps the coal-beds in *Hungary*, 211  
 is vitriolic and furnishes the alum-works at *Commotaw*, 247

*Slickon-sides*, a species of smooth and polished skirts, fimbriæ and coverings or vertical joints in metallic veins, 155—See *Saalband*

*Smolniz*, mining place, 169—175

*Spar*, calcareous, with native gold, 129

—, (*Rose*) at *Joachimsthal*, with red silver ore, 260—272

*Srbi*, name of the *Raizes* in the *Bannat* of *Temeswar*, 14

*Stalactites arsenical*, or arsenic calx dripped in a stalactical form, from *Joachimsthal*, 258

A problematical species, light, red and yellow as amber; vitreous and glossy; 6v;

# I N D E X.

- fy ; resists the acids ; gives  
 no smell when burnt ;  
 found at *Felfo-banya* in the  
 zinnopel gold-and silver-  
 veins, 259  
*Stalactites*, blueish calcedony  
 dripped as stalactites, 199  
*Stocks* or *Stockworks* at *Deva*  
 and *Dognazka*, errone-  
 ously so called, as con-  
 sisting of many coincid-  
 ing and uniting copper-  
 veins, which run in me-  
 tallic rock, and micaceous  
 clay slate, having a de-  
 termined direction and  
 dipping, 50—53—94, 95  
*Stock* at *Facebay*, in grey  
 hornstone, consists of a  
 stratified auriferous cone  
 or stock, containing gold  
 mineralized in pyrites, 113  
 at *Schlackenwald*, in gneiss,  
 consist of granite and tin-  
 ore ; have the form of large  
 inverted cones ; are crossed  
 by some deaf and some me-  
 tallic veins, which seem  
 to continue in the sur-  
 rounding gneiss, uncer-  
 tain whether having re-  
 gular inclosures or slickon-  
 fides (*Stocshneider*) as the  
 tin-stock at *Geyer* in *Sax-*  
*onia* ; seem to be the sum-  
 mits of old granite-peaks,  
 surrounded with gneiss by  
 modern revolutions, 269  
 --271--291  
*Strata*, (*ancient*) granite, ar-  
 gillaceous rock, lime-  
 stone, 236—238  
 ———, (*modern*) thinner  
 and accidental, consist of  
 clay, slate, marle, sand,  
 lime, 237--247  
 ———, (*marine*) on the sum-  
 mit of some of the highest  
 argillaceous and metallic  
 mountains in the *Harz-*  
*forest*, consist of sandstone  
 and petrifications, 250  
*Sulphur*, for its destroying the  
 iron, recommended in the  
 refining of copper, 63  
 How separated from the py-  
 rites at *Smolniz*, 174  
 ———, (*red*) crystallised  
 or sandaraca in white cry-  
 stallised quartz at *Felfo-*  
*banya*, 160  
 ———, on yellow  
 orpiment, 160  
 ———, in cubic  
 fluor, 160  
 ———, native in sand-  
 stone, 195  
*Temeswar*, city, unhealthy,  
 11  
*Tin-ore*, white, from *Schon-*  
*feld*, resembles to white or  
 greenish fat quartz, 294  
*Tin-stocks* at *Schlackenwald*,  
 consist of conical granite-  
 lumps. surrounded with  
 gneiss, 269--271--291  
*Tin-veins* at *Aberdam* in gra-  
 nite, and thence ascending  
 in the incumbent slate,  
 259  
 At *Gottesgab*, carry iron in  
 the upper drifts ; produce  
 tin a middle depth, and  
 may yield silver in a  
 greater depth, as arseni-  
 cal or tin-veins crossed  
 by iron-veins crossed  
 are constantly observed  
 in



# I N D E X.

- in *Saxony* to produce silver  
in the crossing, 264, 265
- Tin-veins*, at *Graupen* in  
gneifs, 312
- At *Platte*, run in granite,  
consist of granite and tin-  
ore, 262, 263
- At *Schlackenwald*, the tin-  
stocks consist of granite,  
inclosed in gneifs, 269
- At *Schonfeld*, run in gneifs  
293
- at *Zinnwald* in granite,  
nite, consist of granite,  
307--309
- At *Aberdam*, the veins in  
granite produce tin;  
those which ascend into  
the incumbent grey mi-  
caceous slate produce sil-  
ver and cobalt, 258
- Tockay*, vitreous black and  
blueish pellucid lava, cal-  
ed thereabouts *Lynx* or  
*Lux-Sapphire*, 167
- Toplitz*, hot wells and coal-  
works, 310, 311
- Topliza*. See gold-veins.
- Tophus*, seems to be pro-  
ced by the sediments of  
hot wells, 194
- Torda* Salt mines, 140
- Transsylvania*. Antiquities  
described by *Kolesori*, 108
- Natural History,  
written by *Koleseri* and *P.*  
*Fridwalzky*, 106
- , called *Ardellia*  
by the *Wallachians*, 14
- Trap*, argillaceous rock;  
*a. blue*; striking fire with  
steel; unmetallic or con-  
taining but small deaf  
veins; cap'd with mica-  
ceous clay-slate, 153--206
- b. black*,
- c. grey* and
- d. greenish*; hardened irony  
bole; contains spar and  
sherl-grains; occurs at  
*Joachimsthal* in large ver-  
tical veins, running in  
black slate, 263, 264  
under ground extremely  
hard; moulders in open  
air into saponaceous bole,  
which dissolves in water,  
264
- contained at *Joachimsthal* in  
the cow-vein a petrified  
and pretended antedilu-  
vian tree, which is de-  
scribed, 265
- Trsztyan* near *Fuezes*. Gold  
mine described, 125
- Tshavojia*. Lead mines in  
blue micaceous clay-slate,  
195
- Vansha* (*Peter*) a generous  
chief of robbers, saved the  
Emperor of *Germany* from  
being taken by the *Turks*,  
10
- Vein* and *Gang* synonyma, 47
- , *Fissures* are smaller  
veins, having a less con-  
stant and steady run and  
dipping, 28, called *Klufte*  
in *Germany*, 28
- , *Combs* or *Wacken* are  
large vertical veins of por-  
phyry, trap and horn-  
stone, 262
- , *Stocks* or *Stockworks*  
are large masses of ore, or  
metallic rock, as nodules  
included and surrounded  
with the mountain-rock;  
they

# I N D E X.

they have no direction or run to any part of the compass, having commonly the form of a large cone. See *Stocks* and *Stockworks*.

*Veins*, the veins run commonly parallel to the valleys, except at *Joachimsthal*, where they are unaffected by the valleys, 257  
254

*Their direction or run*, is determined in *Germany* by the compass or a dial; accordingly those which run from east to west, or *vice versa*, between hour three and nine are eastern or *Morning-veins*; and those which run from south to north, or *vice versa*, between hour nine and three, are called *Northern* or *Midnight-veins*, 257

——, *Their dipping*, or *inclination towards the horizon*, is determined by a quadrant or sector; and they get accordingly different names, 245

—— *vertical* or *standing-veins* are those which dip from ninety to seventy-five degrees.

*Sliding or slipping Veins* (*Tonnlegigt*) those which dip from seventy-five to forty-five degrees.

*Flat veins*, those which dip between forty-five and fifteen degrees.

*Soaring veins*, which dip from fifteen degrees to 0

*Veins*, petrifications in veins, 184, 185--265

See *Cinnabar*, *Copper*, *Gold*, *Iron*, *Lead*, *Quicksilver*, *Silver*, *Tin-veins*. *Saalband*.

*Veins* (*Cross*) or *Cross-Joints*, are called *Kleins* in *Hungary*, 171

——, are such veins as run in the same mountain, but in a contrary direction or contrary dipping to the main vein, so that they cross it either in the run or dipping. In the last case they make what they call in *Germany* a *falling-cross*. They are commonly filled with substances, clay, stones and ores, which are different from those in the main vein, and affect it in a various manner.

——, at *Catharinaberg*, *Joachimsthal* and *Shemnitz* they quicken and improve it, 245, 246--261--182, 183

——, at *Smolnix* the main vein dead, unless quickened by crossing ones, 172

——, their various effect upon the main veins at *Smolnix*, 171

——, at *Felső-banya* strike the main vein dead, 160

See *Cinnabar*, *Copper*, *Gold*, *Iron*, *Lead*, *Quicksilver*, *Tin-veins*.

*Ventilator* and air-conductors in the gold-mines at *Nagyag*, 100

*Vitriol*



# I N D E X.

- Vitriol*, how separated from pyrites, 175
- Volcanic productions*, scarce in *Hungary*, 213  
See *Metallic-rock*; *Lava*. *Sapphire*.
- Wacken*; German popular name for large veins of hard rocks, such as porphyry and trap, 262
- Wallachia*; by the inhabitants called *Zara-more*, 14
- Wallachians*, call themselves *Romun*, and seem to be remainders of ancient Roman colonies, 14
- , their language corrupt *Latin*, 14
- , agrees with the common *Italian* in many qualities, 14
- , their manners in the *Bannat*, 15
- , their religion the non-united *Greek*, 17
- , make use of the *Greek* alphabet, 23
- , in *Transsylvania* more humanized and industrious, 94--137
- Wolfram*; the fore-runner of tin in the tin-veins at *Platte*, which run in and consist of granite, 263
- Wood*, petrified and irony in the clay beds near *Ofen*, 252
- , petrified found in a trap-vein, which runs in old slate-rock at *Joachimsthal*, 265
- Zalathna*, metropolis of the *Wallachians*; a great mining place in *Transsylvania*, 108--110--120
- Zara-more*, *Wallachian*, name of *Wallachia* 14
- Zinnopel*; red auriferous jasper, contains gold, silver, lead, zinc and pyrites, 216--188
- , some looser parts and samples look as red boles, 216
- , chief rock of the veins at *Shemnitz*, which run in metallic rock, 182--189
- , petrified, *madrepore* or *porpites* found in its vein at *Shemnitz*, 184
- , at *Felső-banya* the *zinnopel*-veins run in metallic rock and hornstone, contain auriferous silver, 159--164
- , with native gold from *Olalapos*, 166

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